20f020 "t6059901

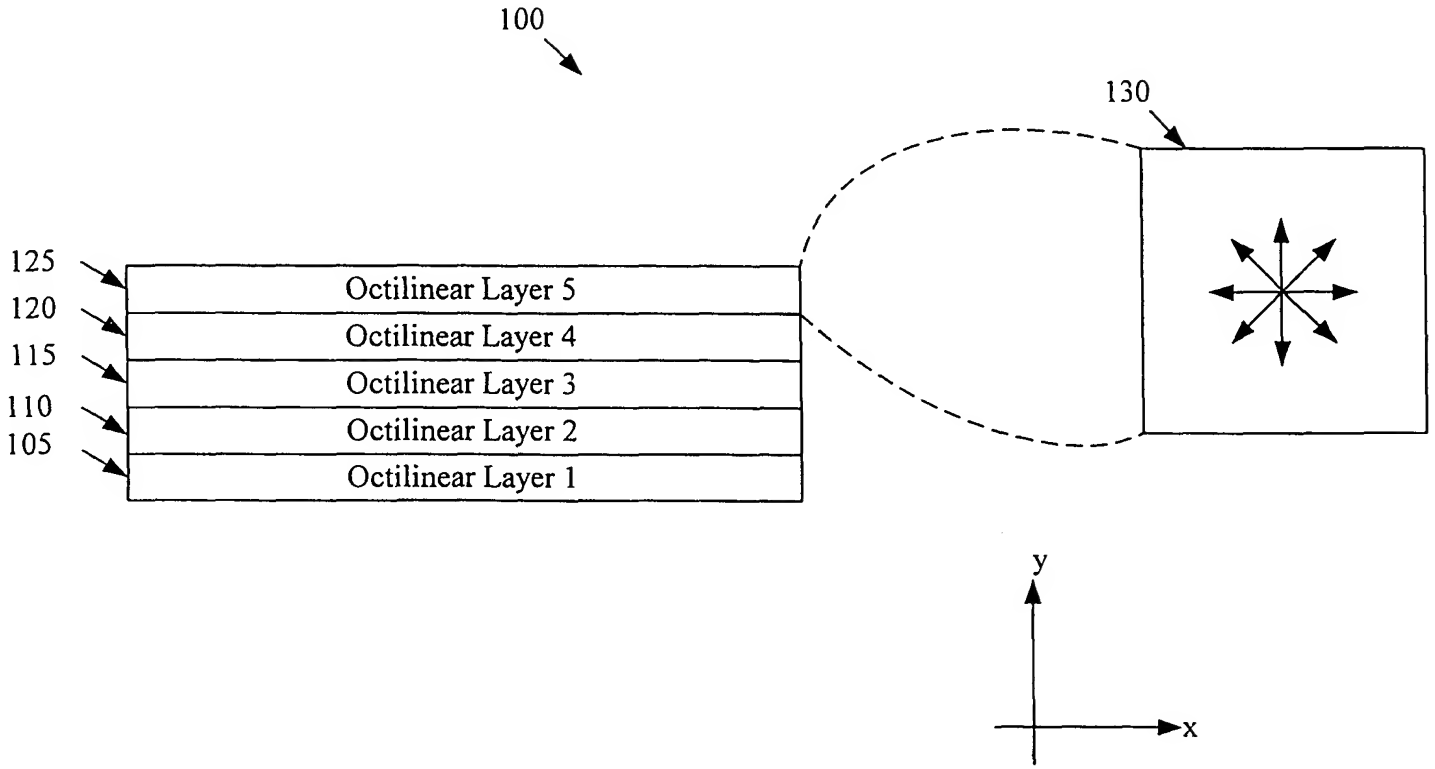


Figure 1

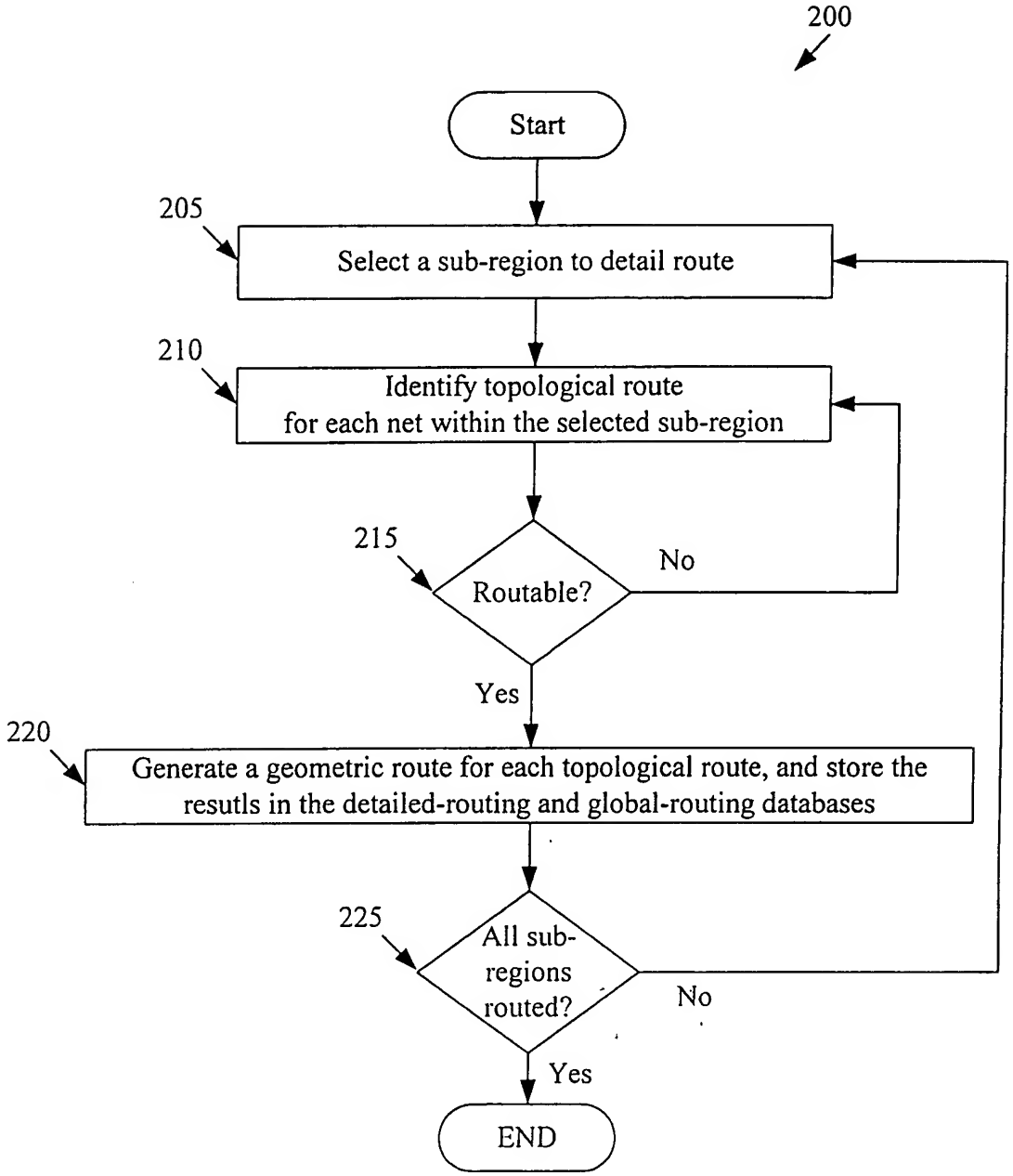

200
Start
205
Select a sub-region to detail route
210
Identify topological route
for each net within the selected sub-region
215
Routable?
No
Yes
220
Generate a geometric route for each topological route, and store the resutls in the detailed-routing and global-routing databases
225
All sub-regions routed?
No
Yes
END

Figure 2

20070"th09980T

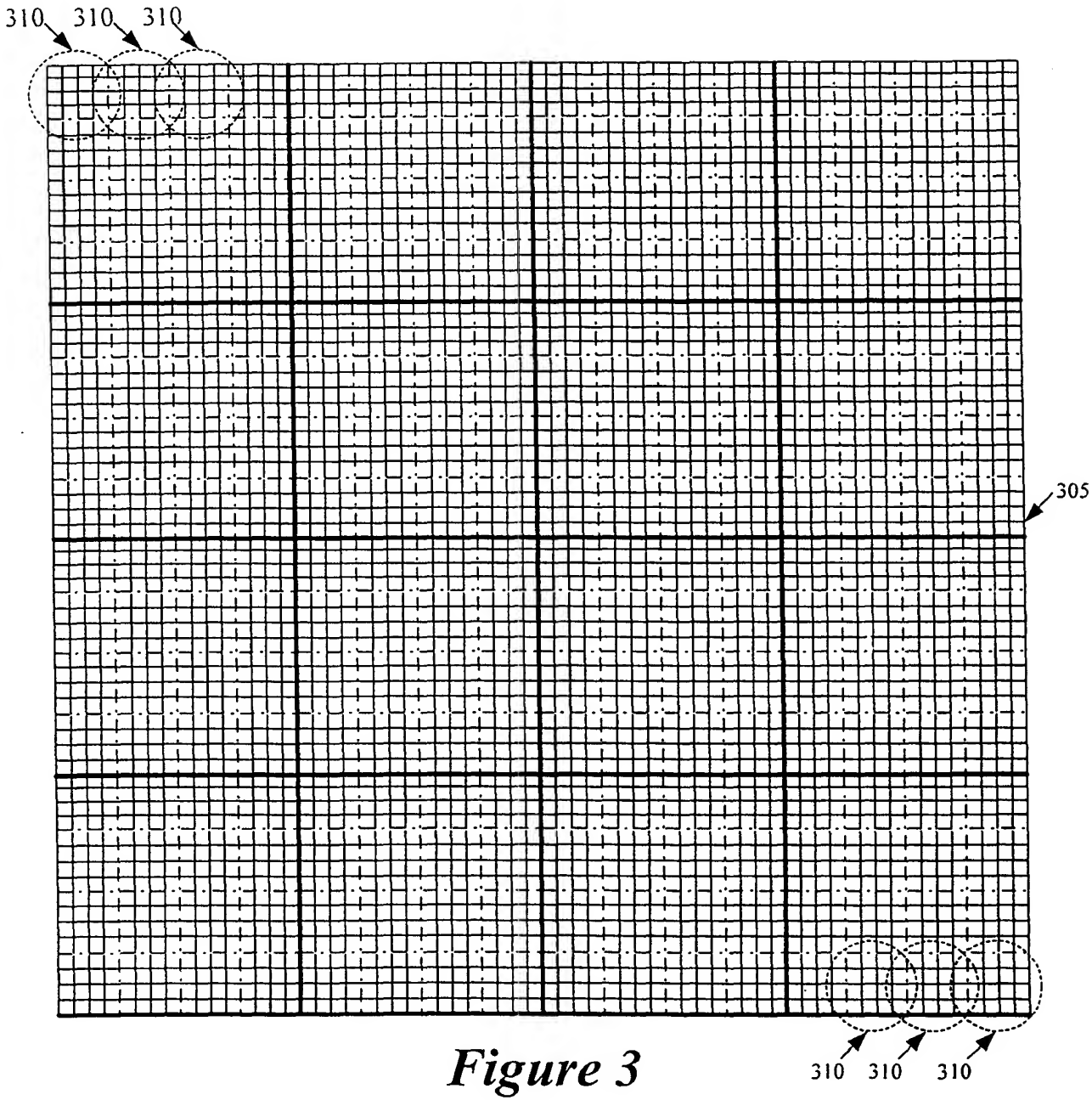


Figure 3

20020049907

Figure 4

20T070"tb099081

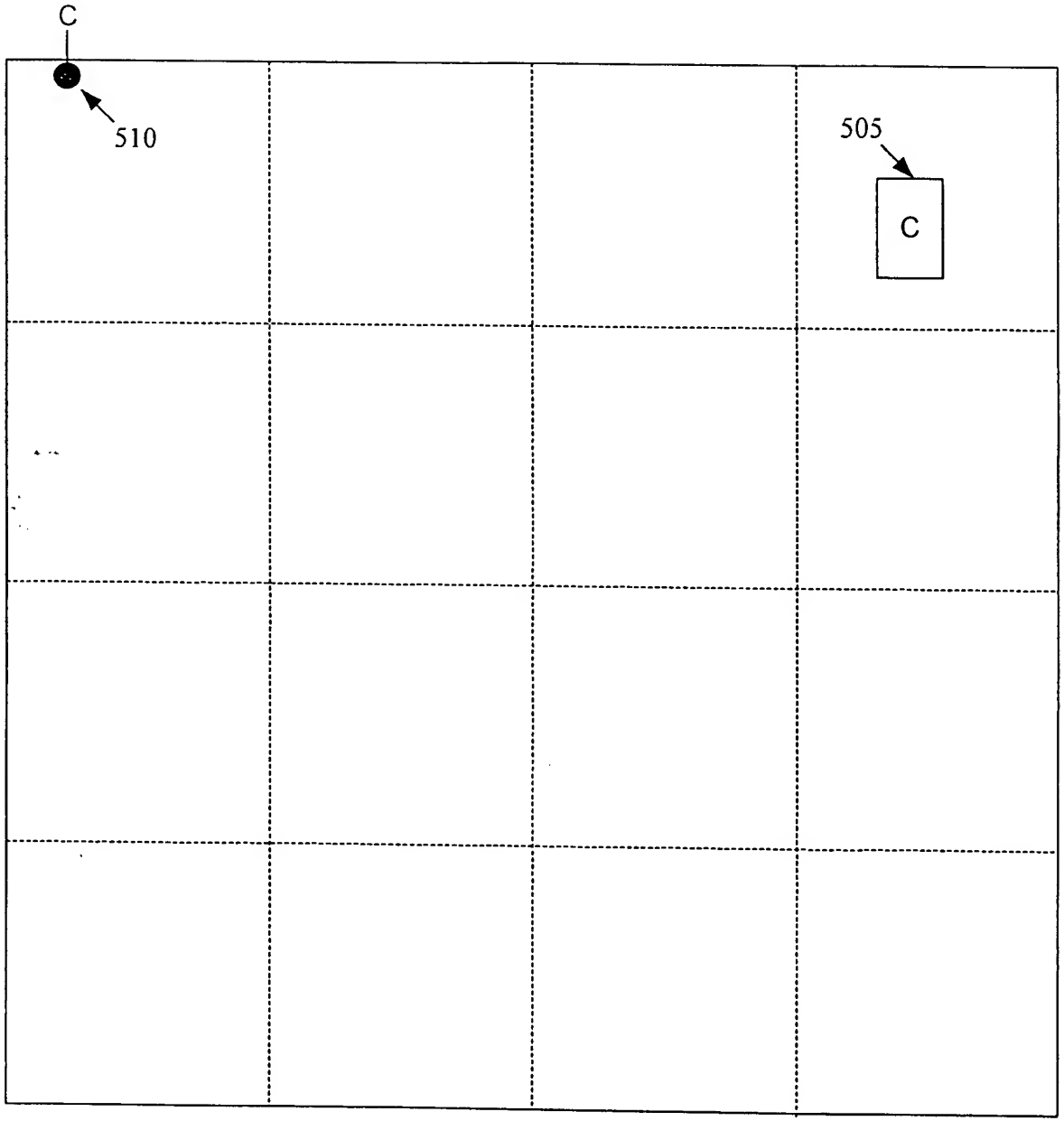


Figure 5

20T070"t609980T

-List of Geometries
--Each Geometry including a sequence of points & layer assignment
-Bounding box of the region
-Array of layer properties
--Minimum wire size
--Minimum spacing
--Via sizes
--Cost/Unit
-Netlist specifying a number of nets
--Each net specifying a set of pins
--Each pin specifying a set of ports
--Each port specifying a set of geometries

Figure 6

-List of Geometries
--Each Geometry including a sequence of points & layer assignment
--List of connection nodes inside each pin geometry
-Bounding box of the region
-Array of layer properties
--Minimum wire size
--Minimum spacing
--Via sizes
--Cost/Unit
-Netlist specifying a number of nets
--Each net specifying a set of pins
--Each pin specifying a set of ports
--Each port specifying a set of geometries
-For each layer, a graph specifying
--Nodes
--Edges
--Faces

Figure 7

20T020"+6039908T

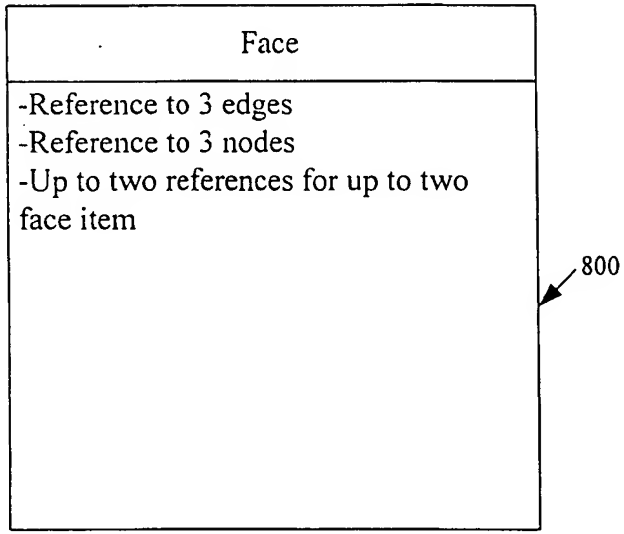


Figure 8

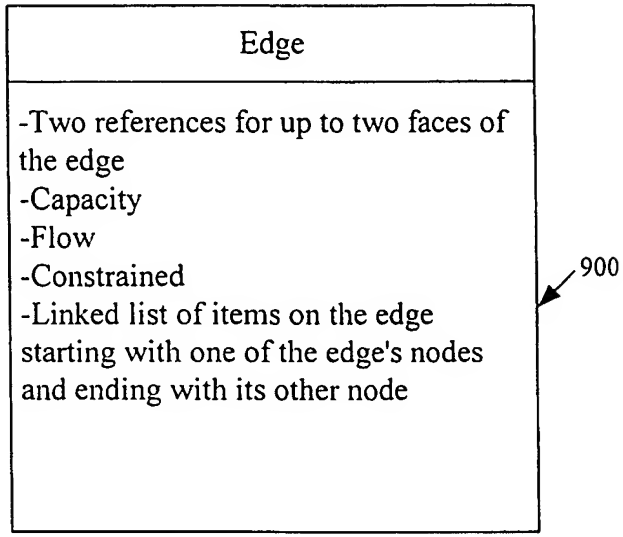


Figure 9

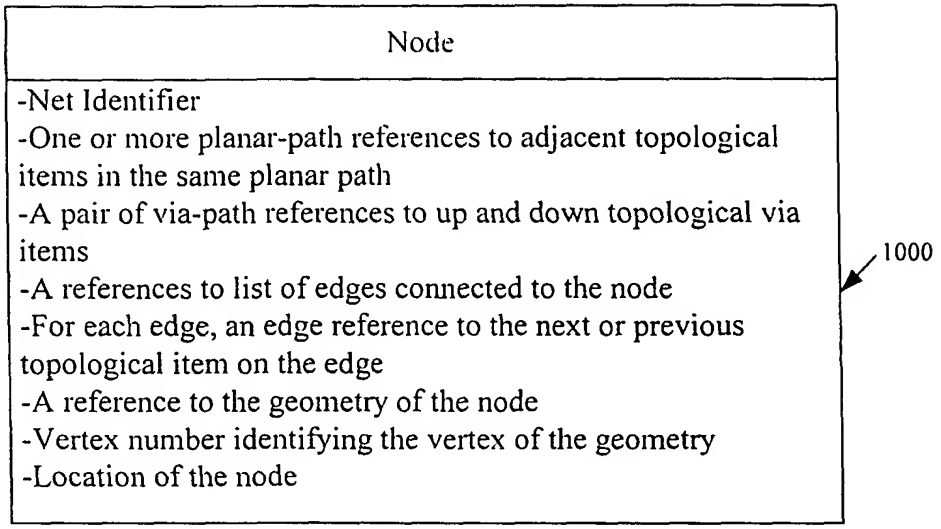


Figure 10

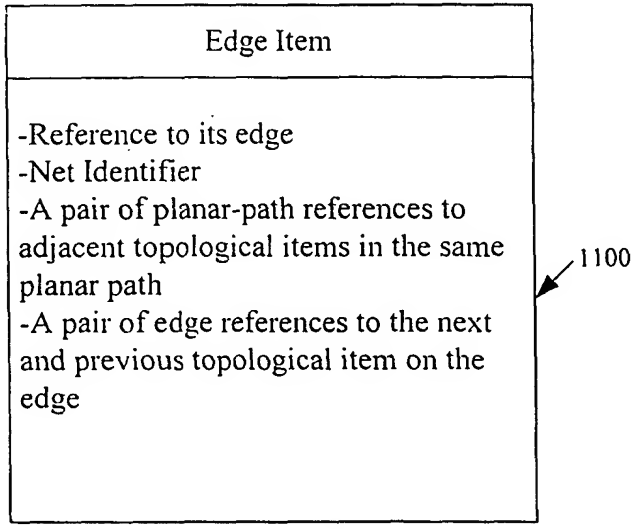


Figure 11

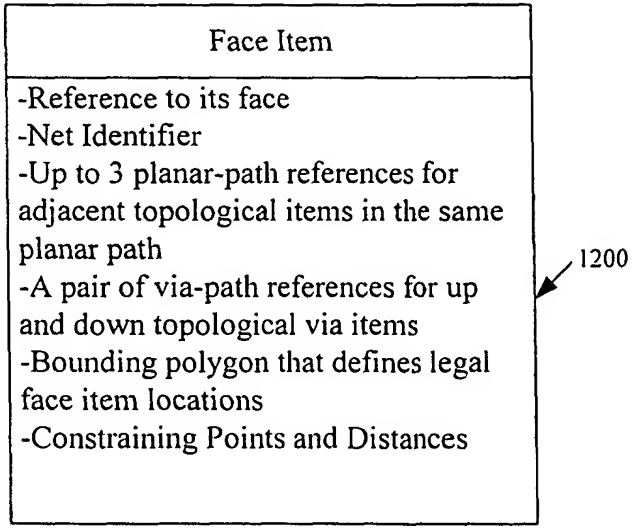
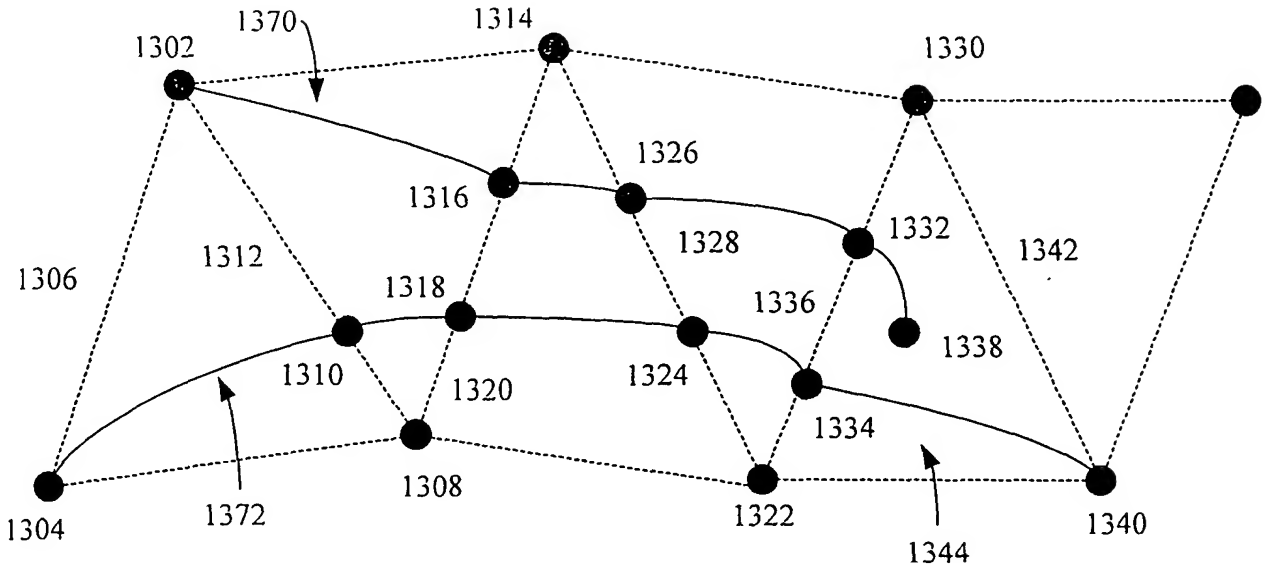
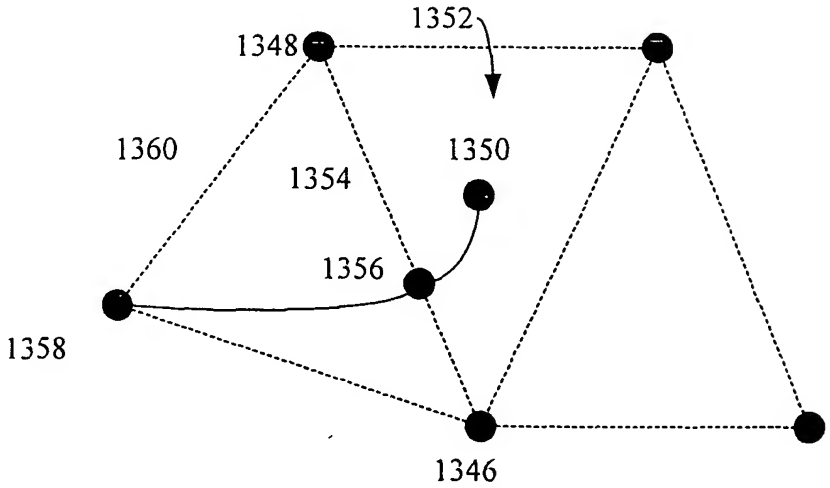


Figure 12



Layer 2



Layer 3

Figure 13

20T020"h6099001

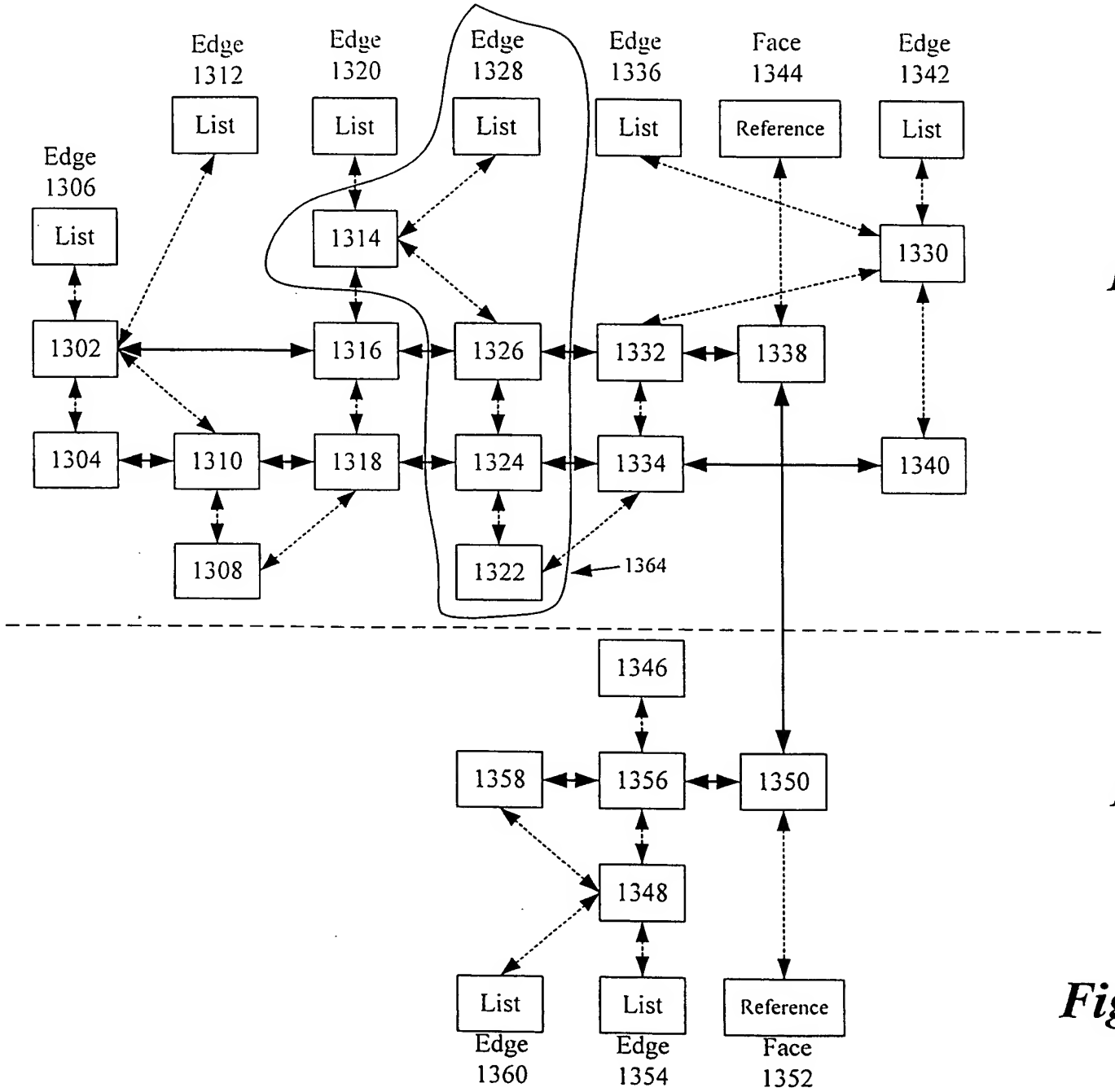


Figure 14

20070294664

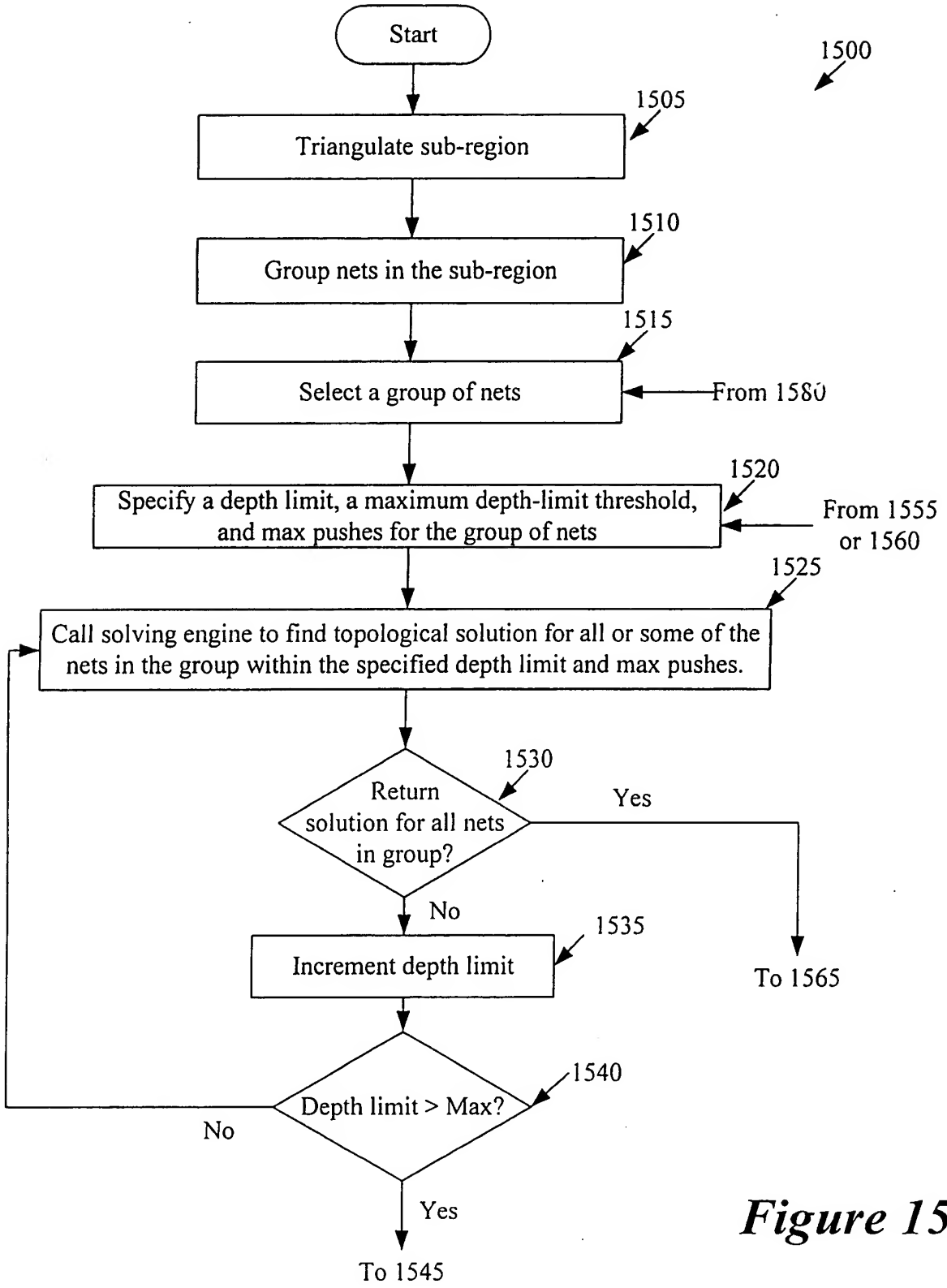


Figure 15A

Figure 15: *Figure 15A* / *Figure 15B*

10656534 - 070502

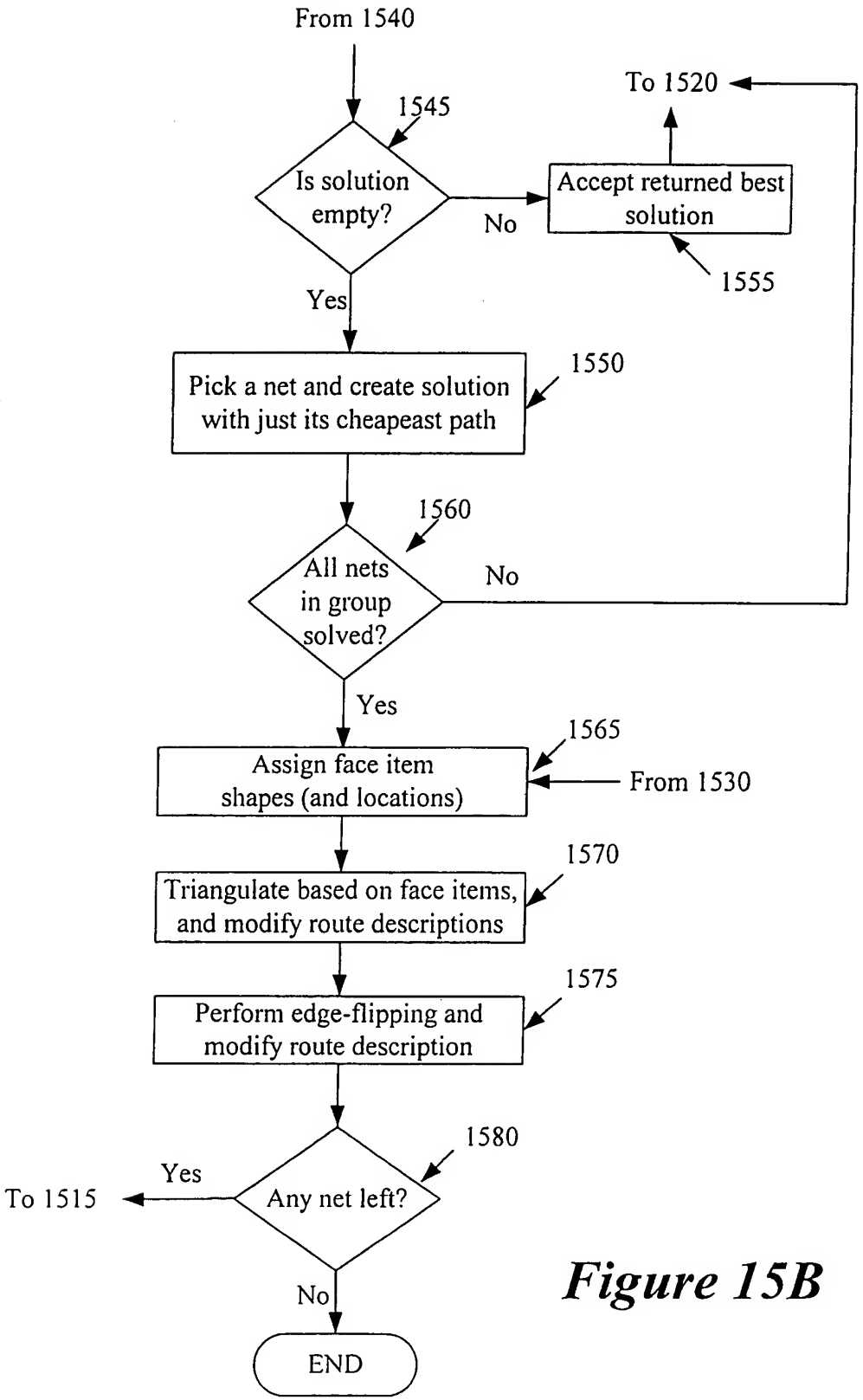


Figure 15B

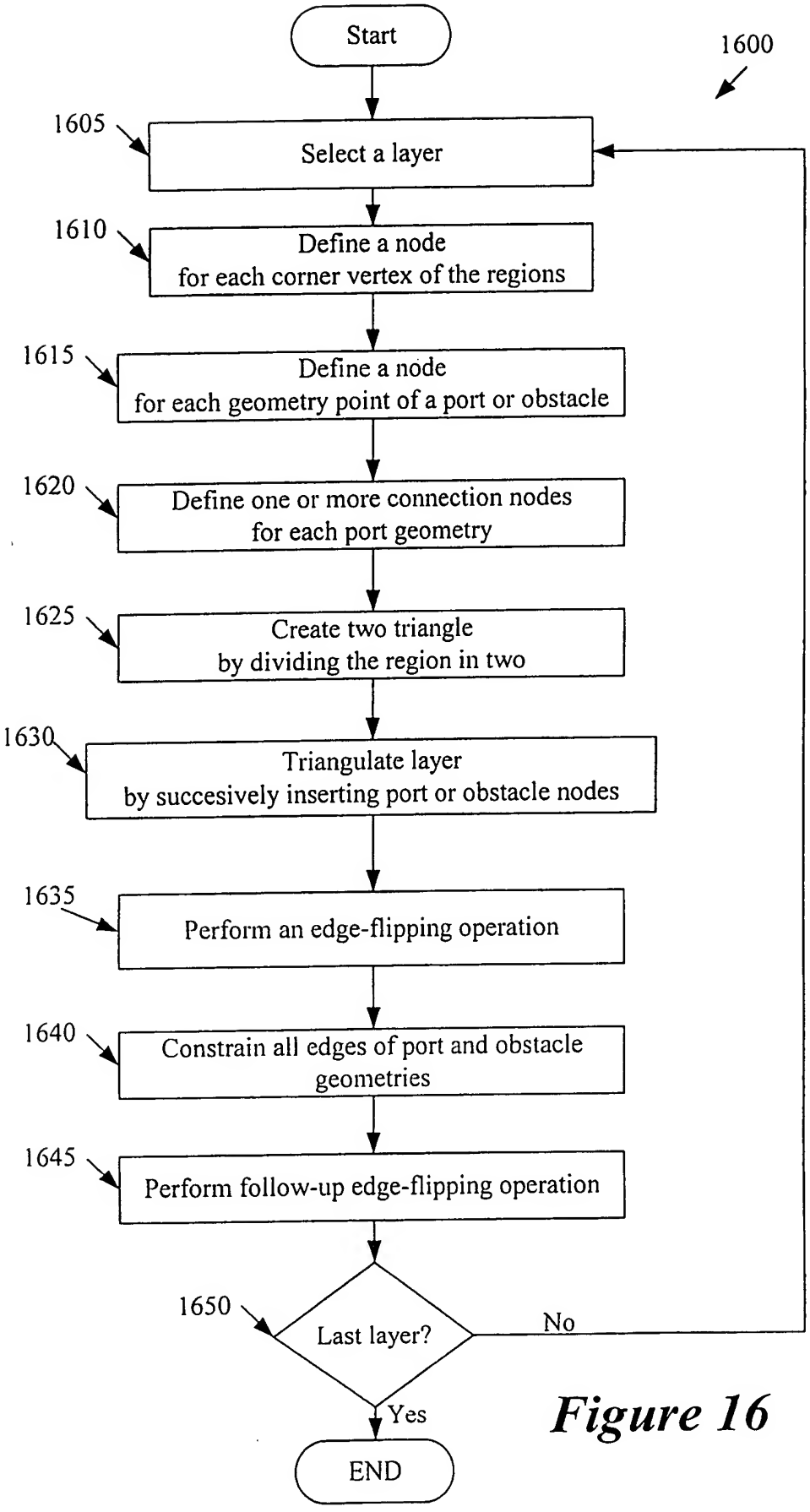

Start
1600
1605
Select a layer
1610
Define a node
for each corner vertex of the regions
1615
Define a node
for each geometry point of a port or obstacle
1620
Define one or more connection nodes
for each port geometry
1625
Create two triangle
by dividing the region in two
1630
Triangulate layer
by succesively inserting port or obstacle nodes
1635
Perform an edge-flipping operation
1640
Constrain all edges of port and obstacle
geometries
1645
Perform follow-up edge-flipping operation
1650
Last layer?
No
Yes
END

Figure 16

20040504-050501

Figure 17

20T020"+6099081

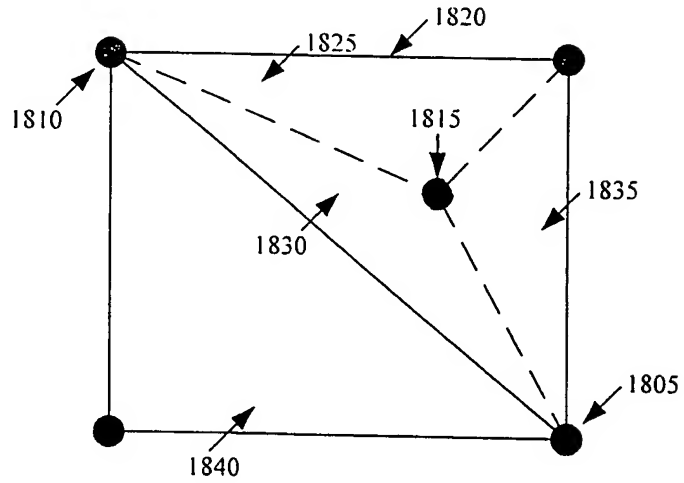


Figure 18

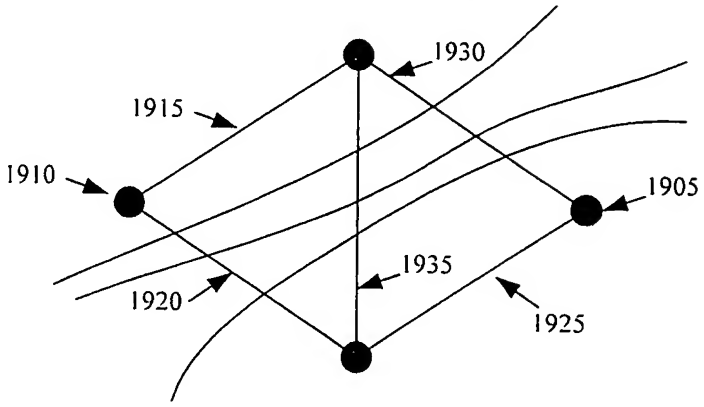


Figure 19

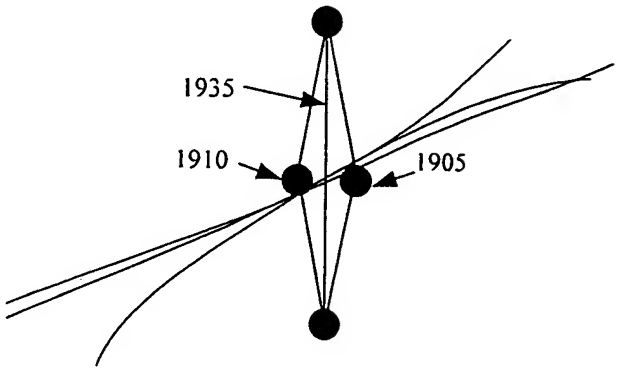


Figure 20

20T020"th6099001

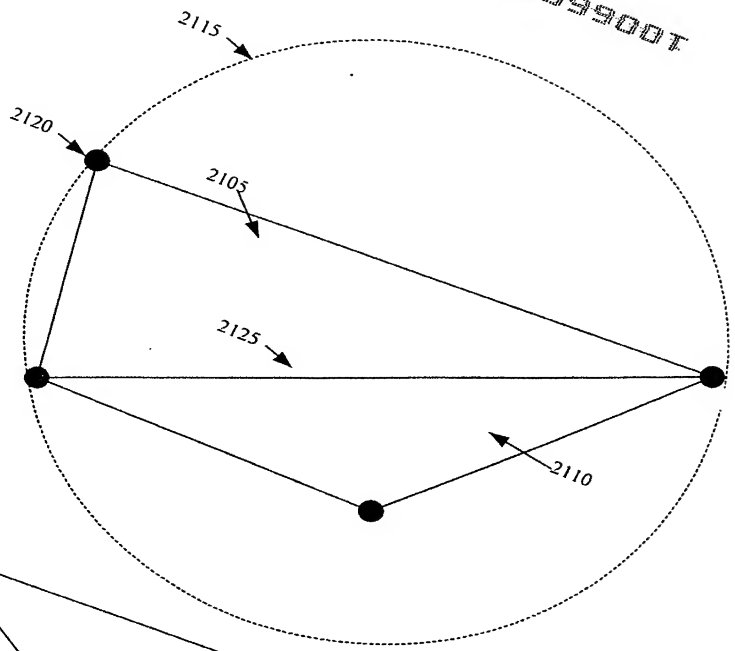


Figure 21

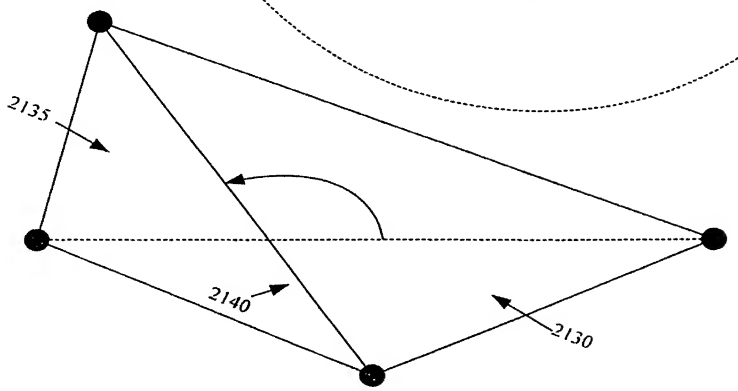


Figure 22

2005-0705-4695901

Figure 23

DRAFT "4/3/2001

Figure 24

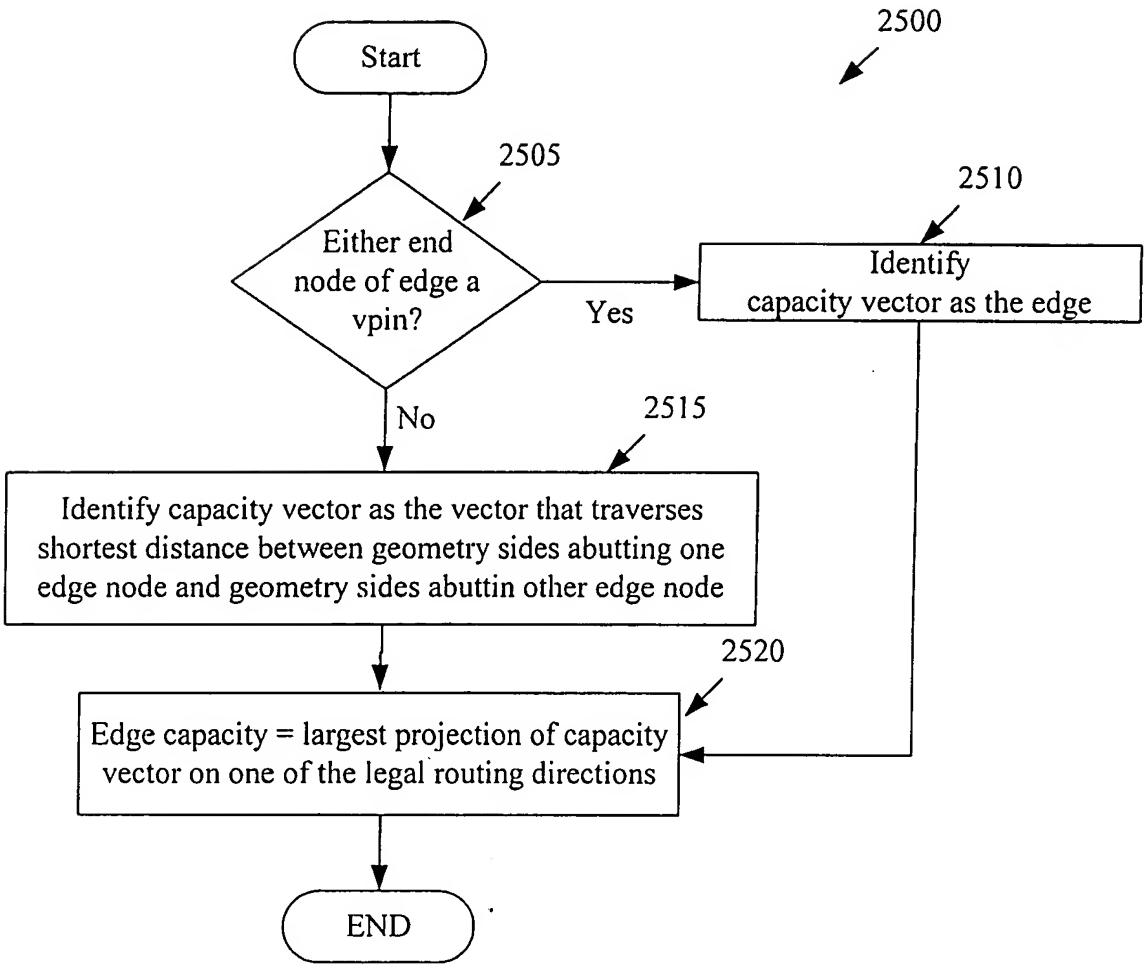

2500
Start
2505
Either end node of edge a vpin?
Yes
2510
Identify capacity vector as the edge
No
2515
Identify capacity vector as the vector that traverses shortest distance between geometry sides abutting one edge node and geometry sides abuttin other edge node
2520
Edge capacity = largest projection of capacity vector on one of the legal routing directions
END

Figure 25

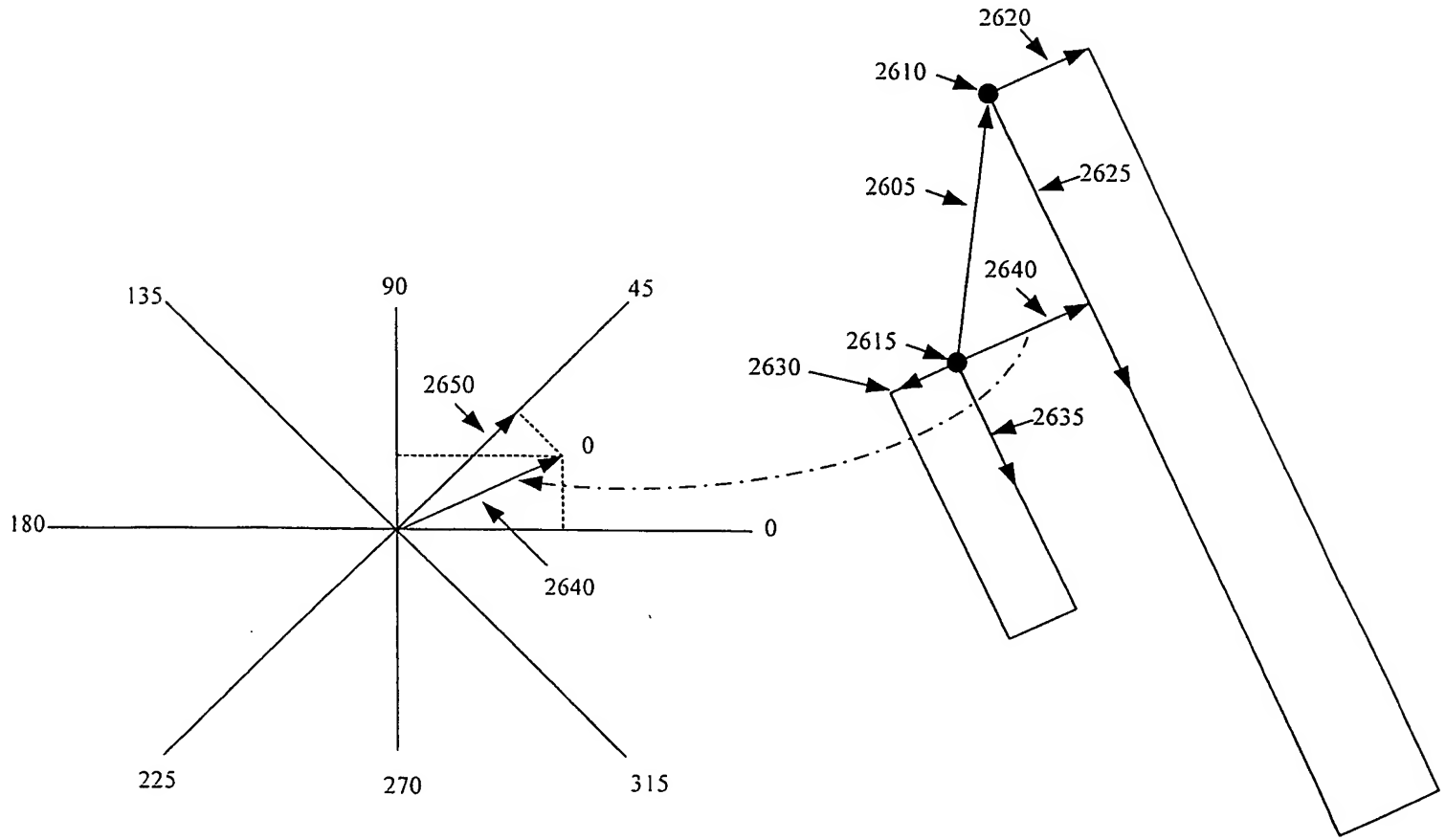

2620
2610
2605
2625
2640
2615
2630
2635
135
90
45
2650
0
180
0
2640
225
270
315

Figure 26

20T070"+609908T

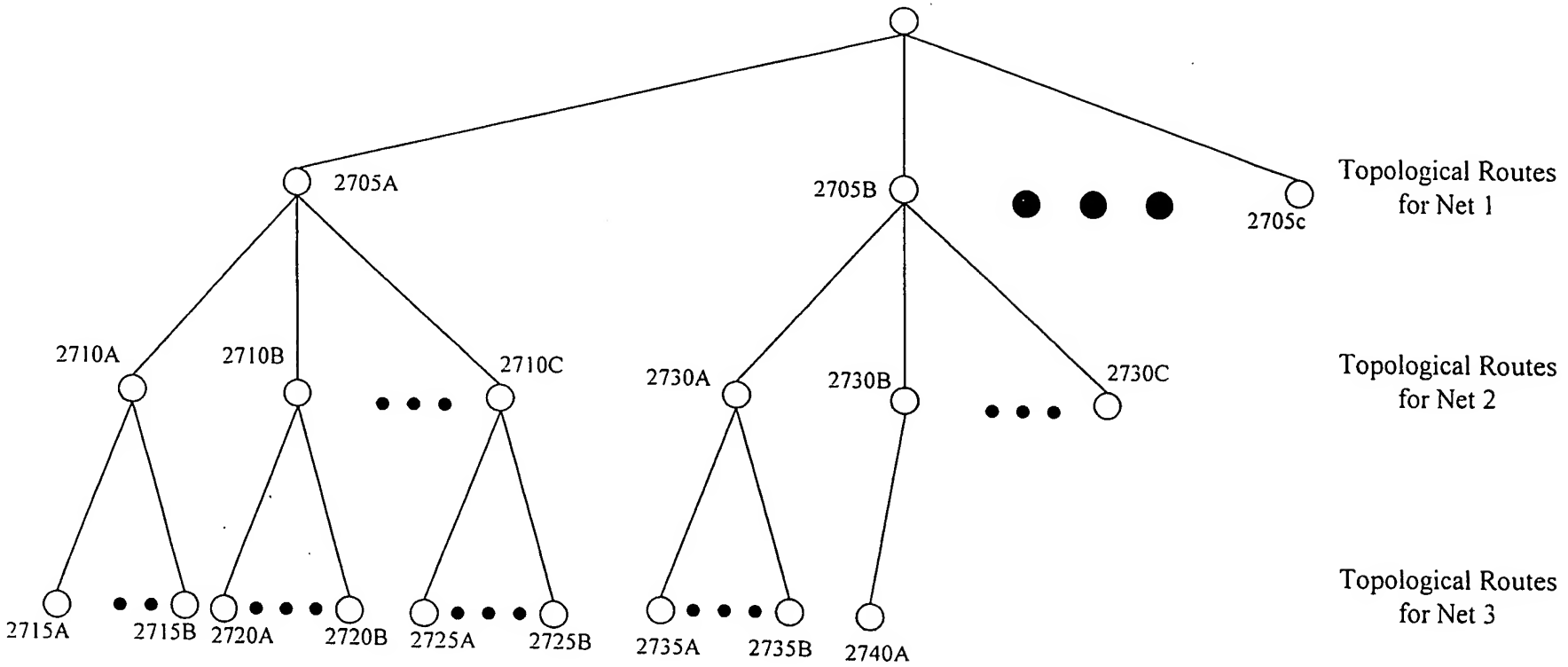


Figure 27

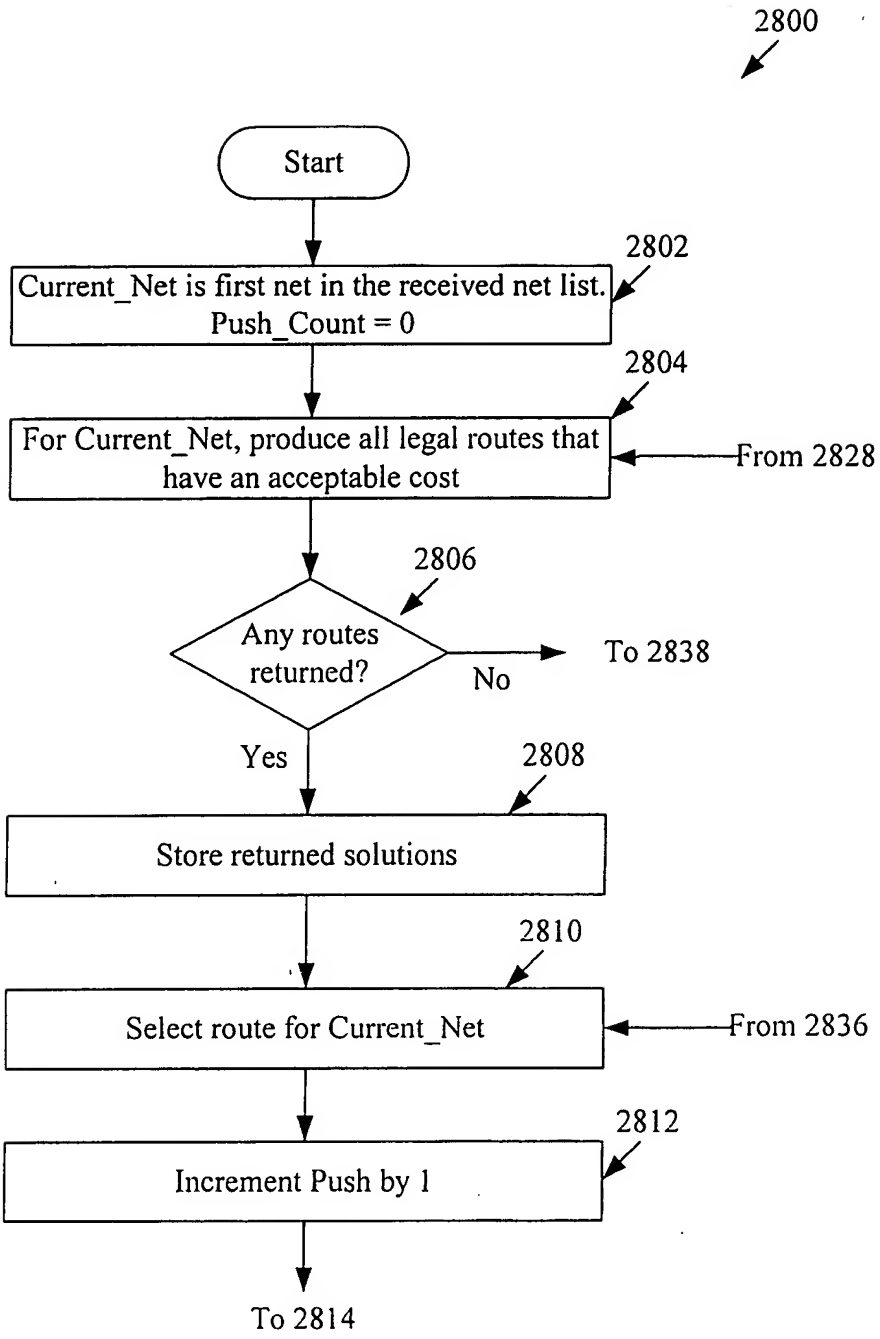


Figure 28A

Figure 28: *Figure 28A* / *Figure 28B* / *Figure 28C*

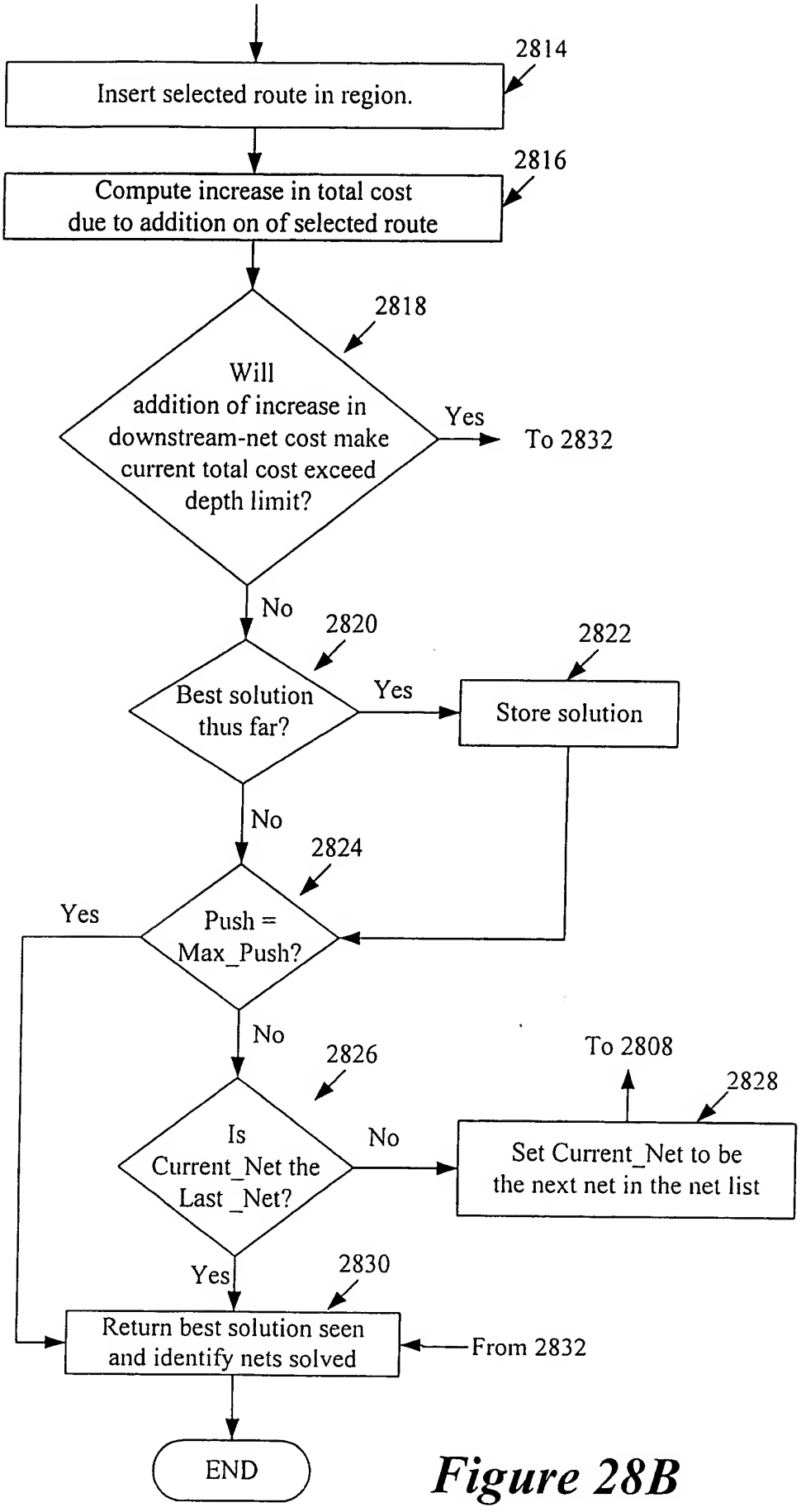

2814
Insert selected route in region.
2816
Compute increase in total cost due to addition on of selected route
2818
Will addition of increase in downstream-net cost make current total cost exceed depth limit?
Yes
To 2832
No
2820
Best solution thus far?
Yes
2822
Store solution
No
2824
Push = Max_Push?
Yes
No
2826
Is Current_Net the Last _Net?
No
To 2808
2828
Set Current_Net to be the next net in the net list
Yes
2830
Return best solution seen and identify nets solved
From 2832
END

Figure 28B

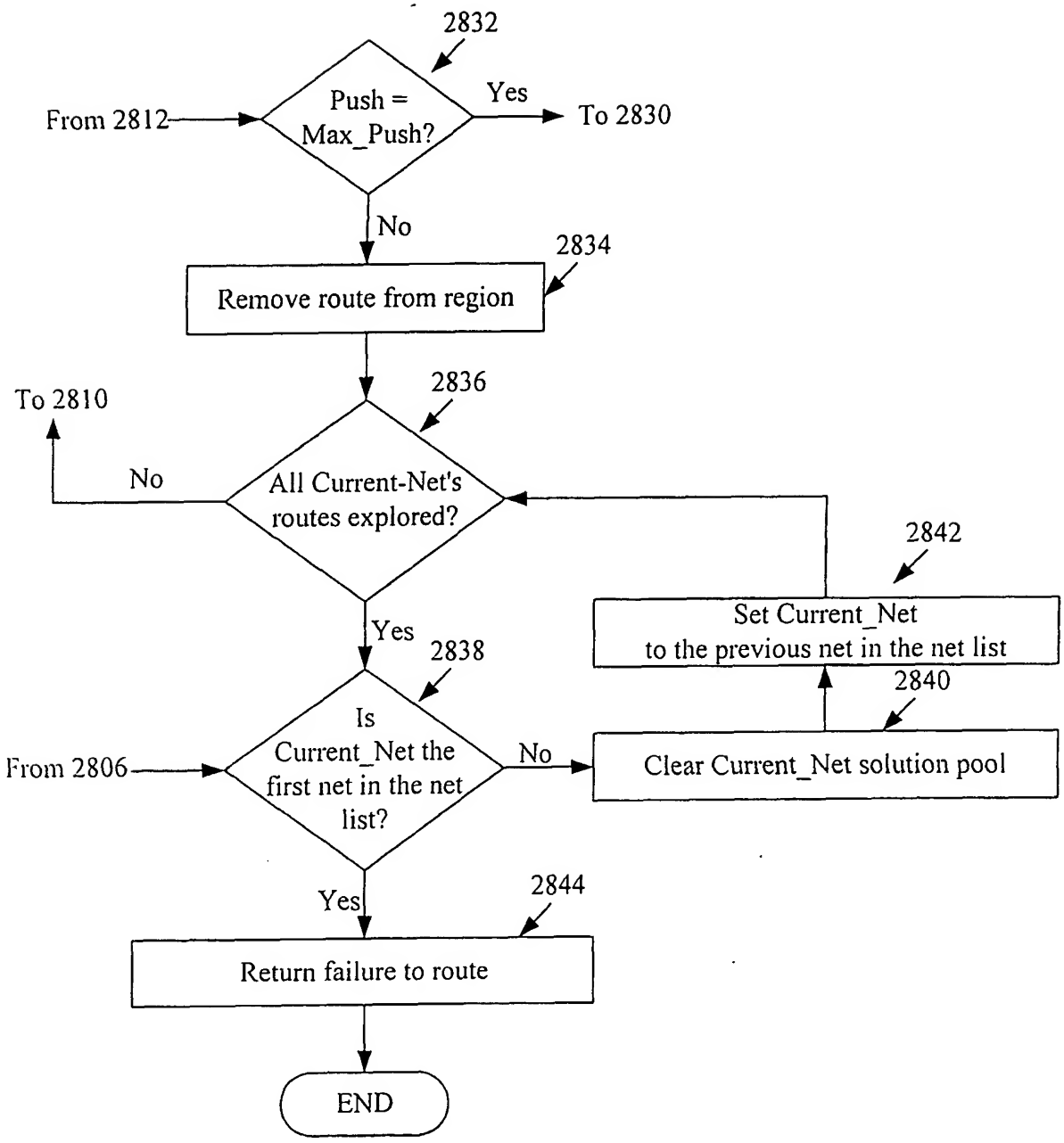

2832
From 2812
Push = Max_Push?
Yes
To 2830
No
2834
Remove route from region
2836
To 2810
No
All Current-Net's routes explored?
2842
Set Current_Net to the previous net in the net list
Yes
2838
2840
From 2806
Is Current_Net the first net in the net list?
No
Clear Current_Net solution pool
Yes
2844
Return failure to route
END

Figure 28C

1005594 "07/03/02

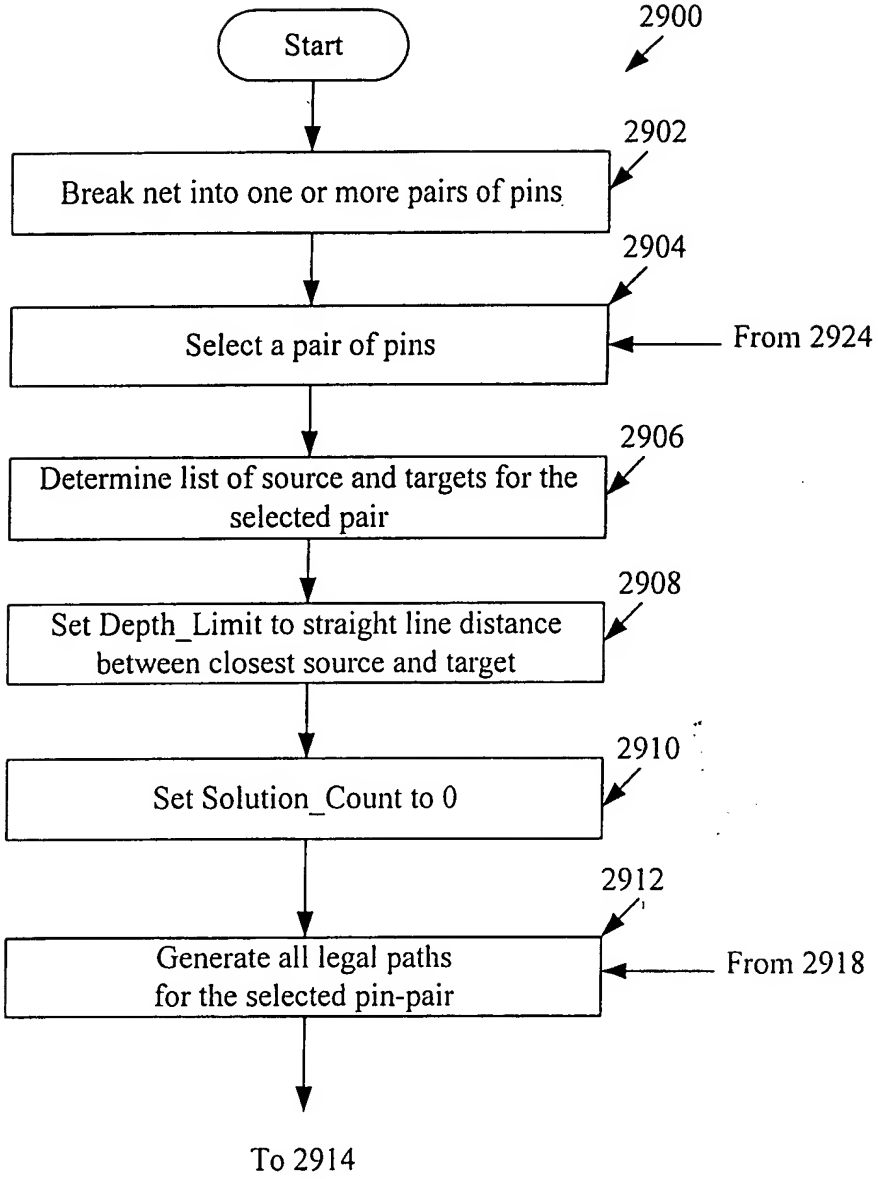


Figure 29A

Figure 29: *Figure 29A* / *Figure 29B*

EDS5154 "07/07/05

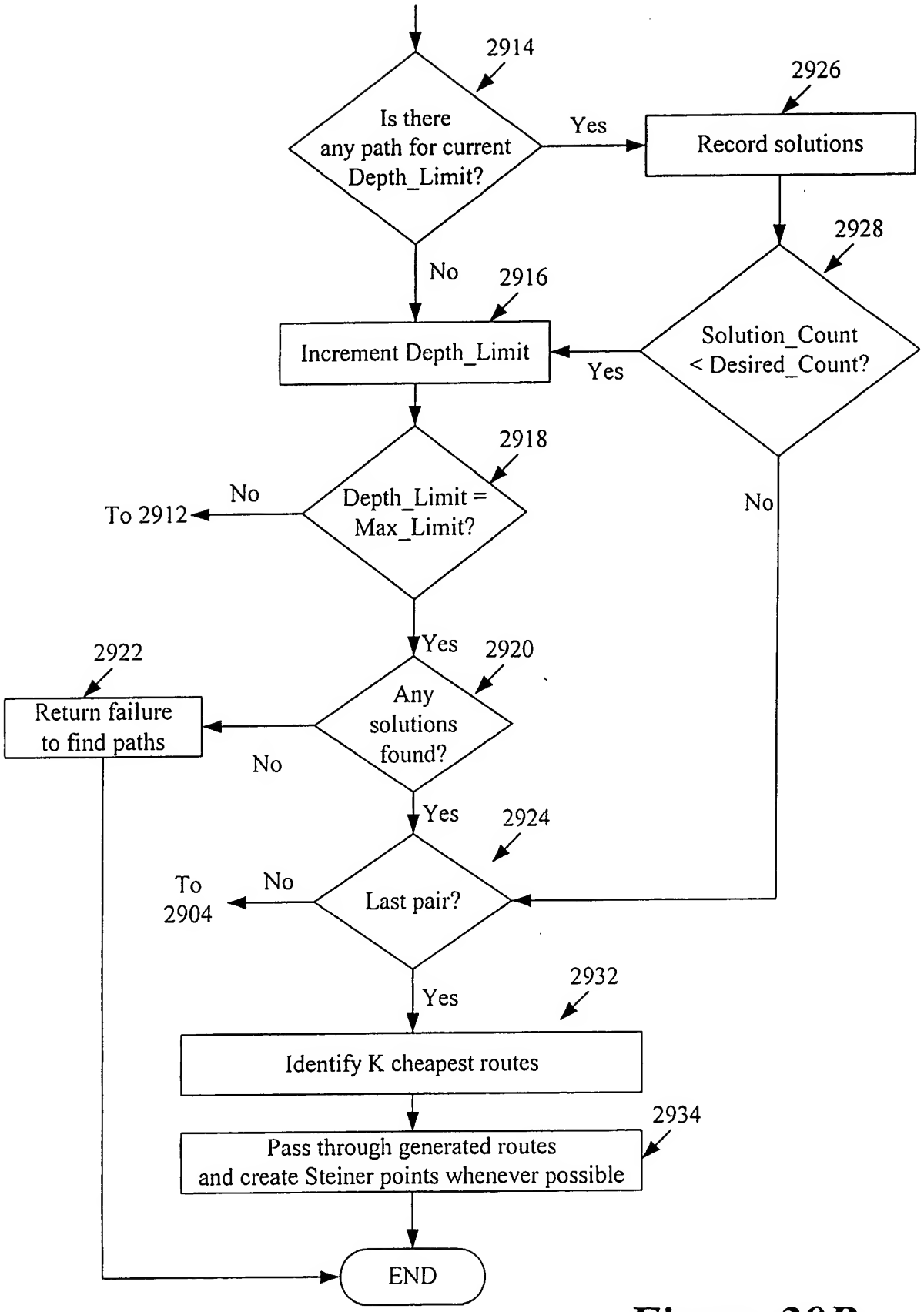


Figure 29B

20150470 "16093907

Figure 30A

Figure 30B

Figure 32

Figure 33

Figure 34

20070704.0759.1

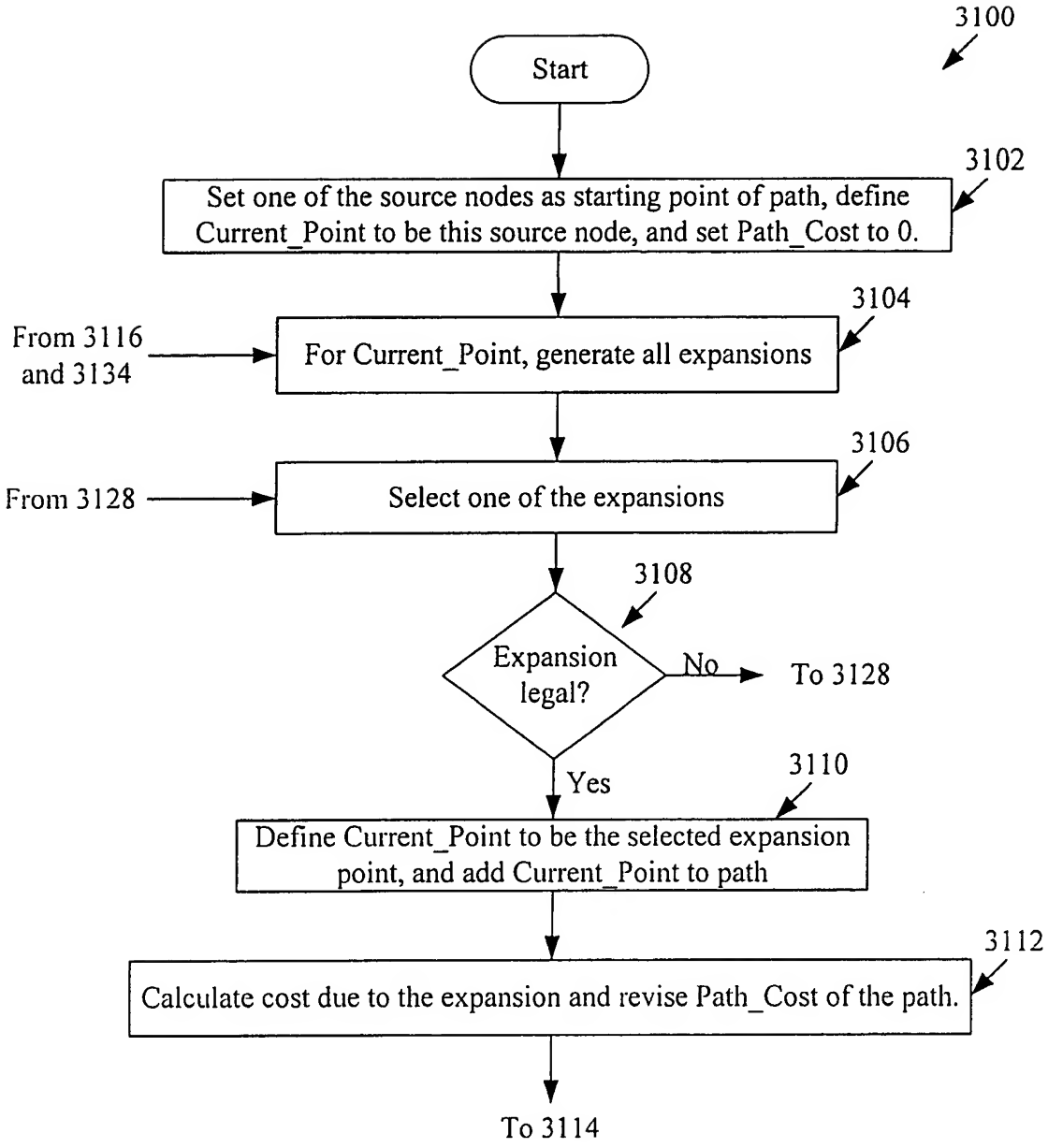


Figure 31A

Figure 31: *Figure 31A* / *Figure 31B*

20150704-4504500-1

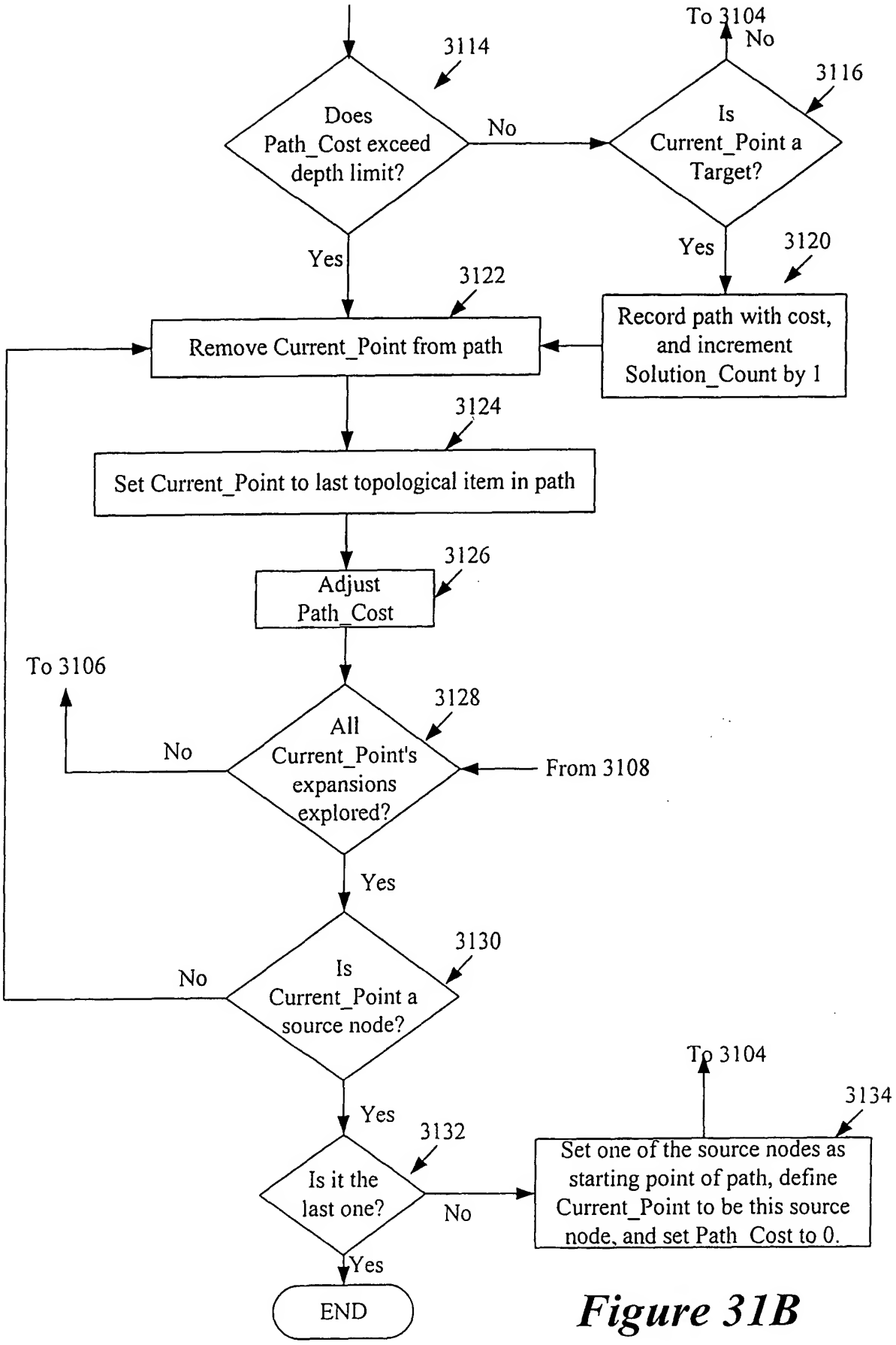


Figure 31B

20T070"th09900T

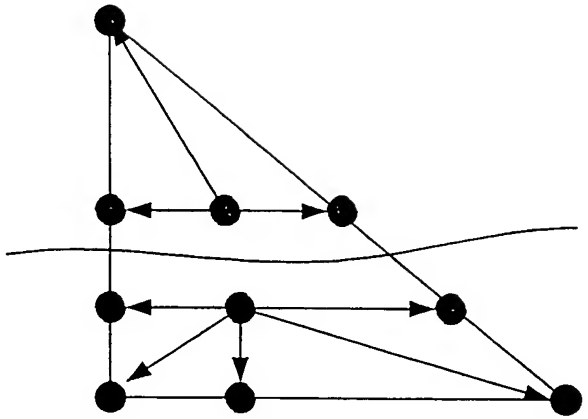


Figure 35

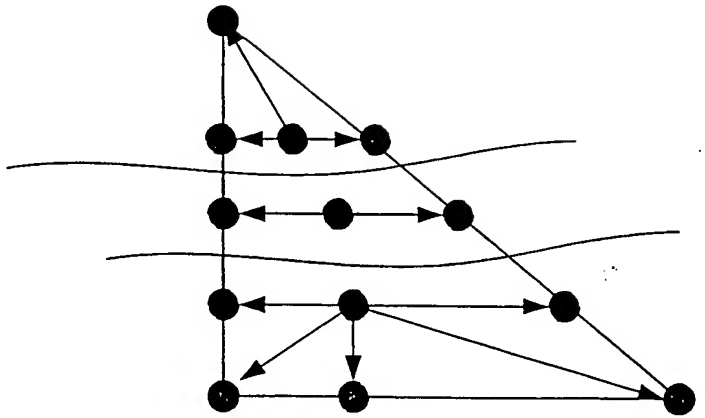


Figure 36

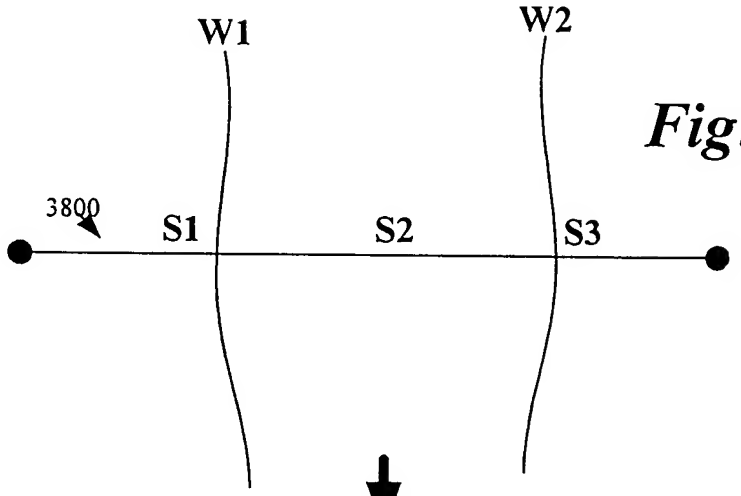


Figure 38A

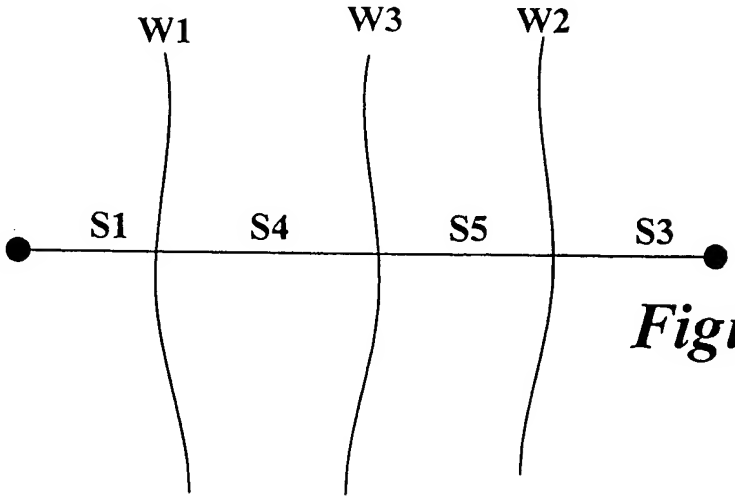


Figure 38B

From: \ To:	Node	Face Item	Edge Item
Node	• Planarity • Vias	• Vias	• Planarity • Vias • Edge Capacity
Face Item	• Vias	• Vias	• Vias • Edge Capacity
Edge Item	• Planarity • Vias	• Vias	• Planarity • Vias • Edge Capacity

Figure 37

1005694-070102

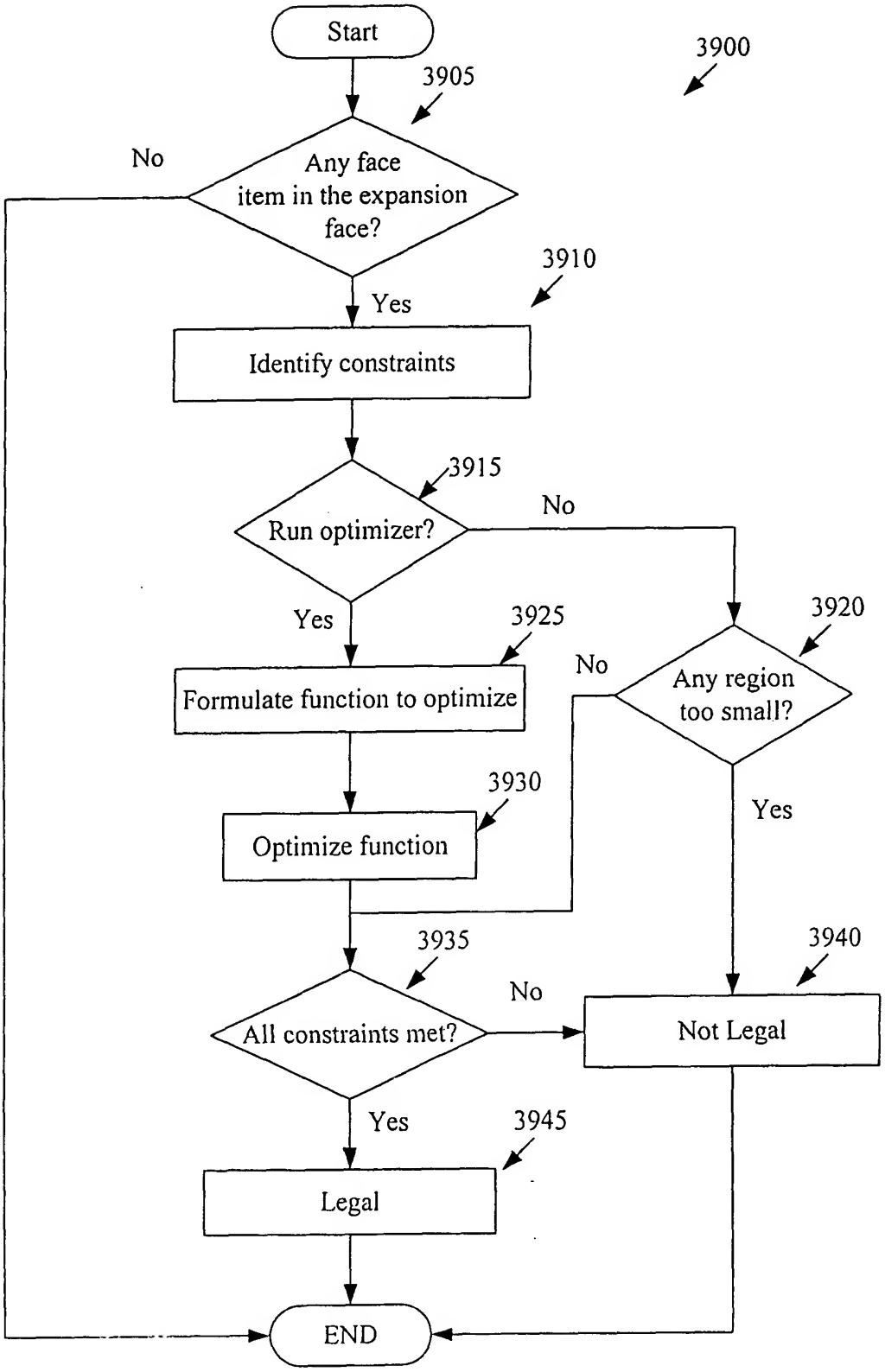


Figure 39A

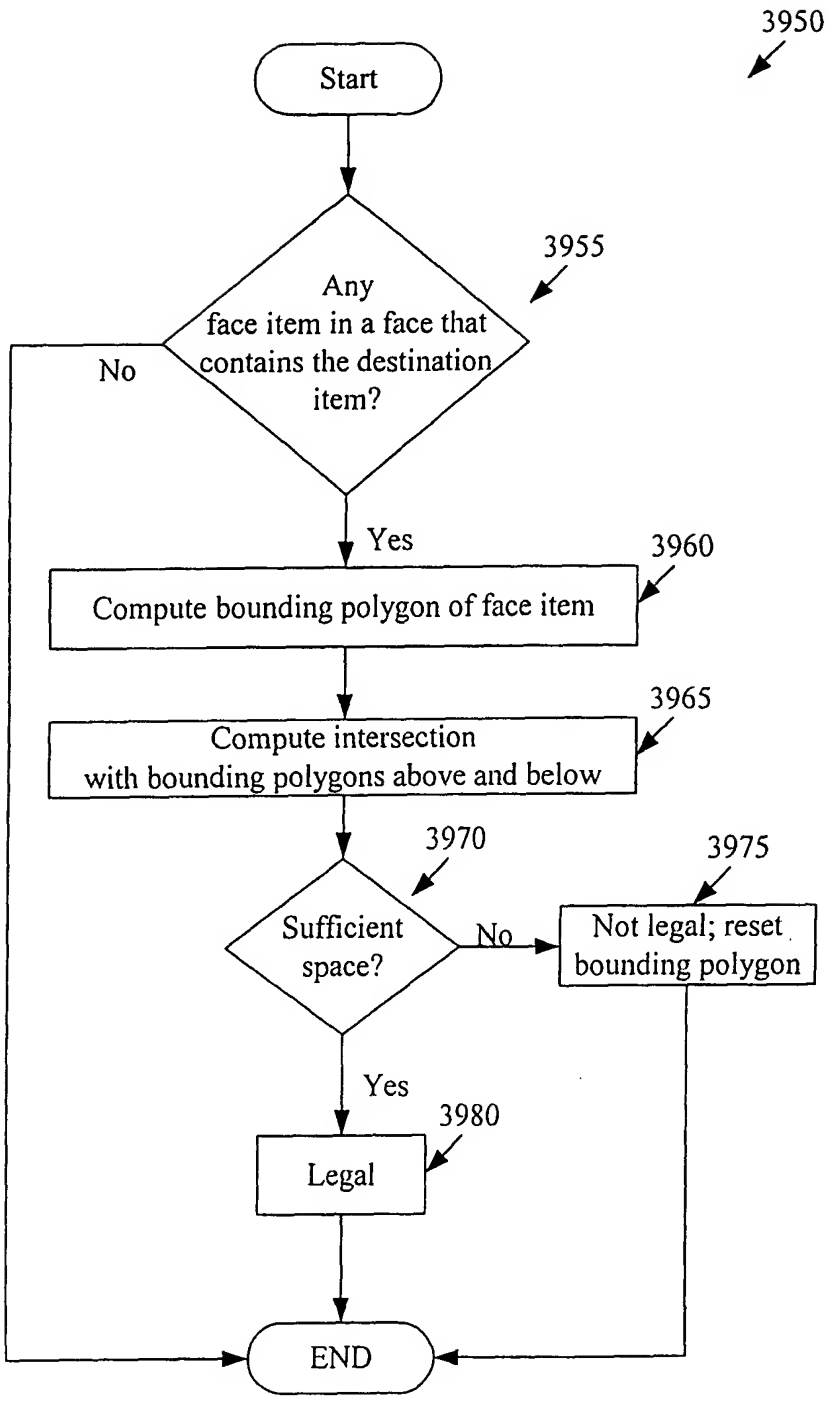

3950
Start
3955
Any face item in a face that contains the destination item?
No
Yes
3960
Compute bounding polygon of face item
3965
Compute intersection with bounding polygons above and below
3970
Sufficient space?
No
3975
Not legal; reset bounding polygon
Yes
3980
Legal
END

Figure 39B

US 6,957,404 B2

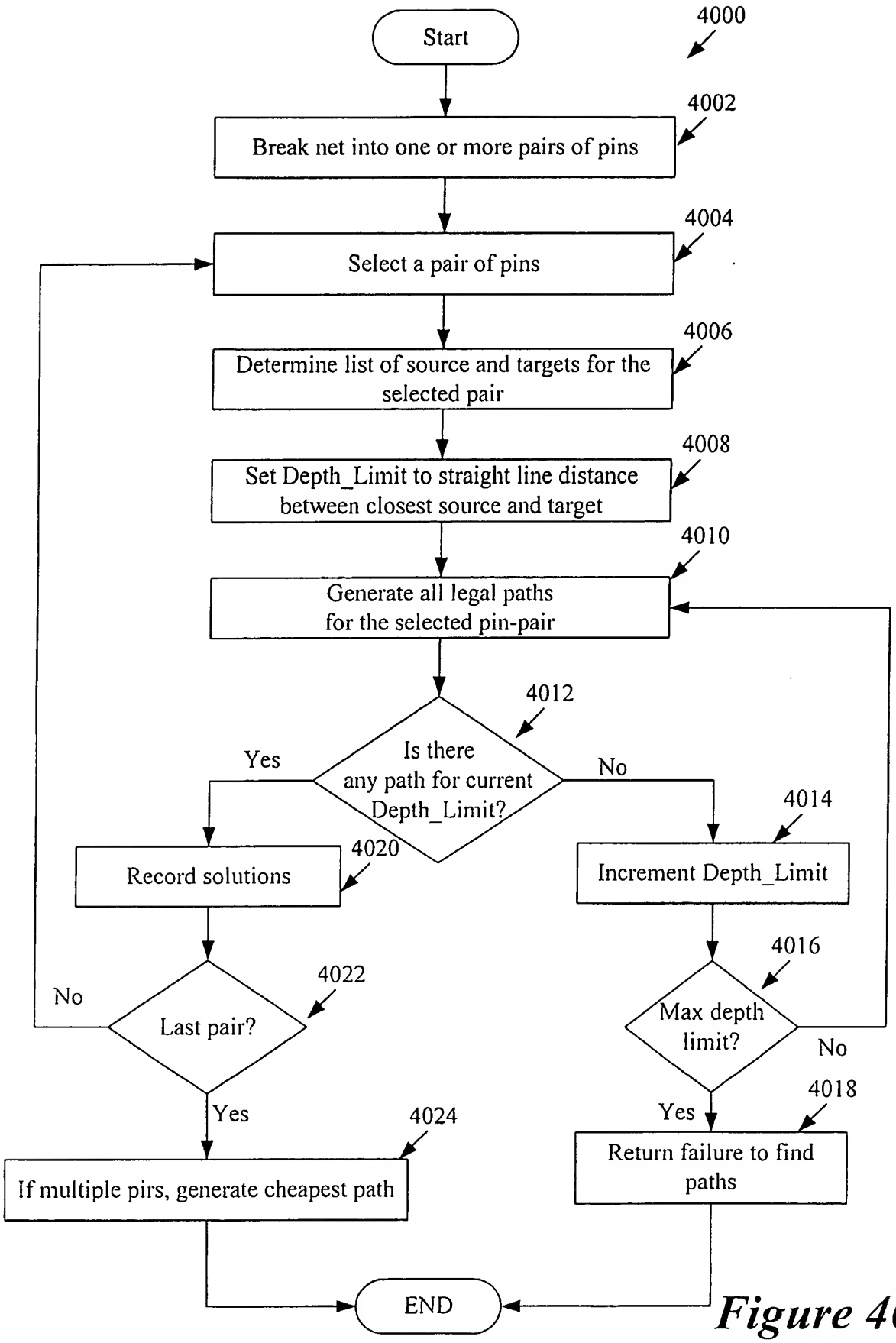


Figure 40

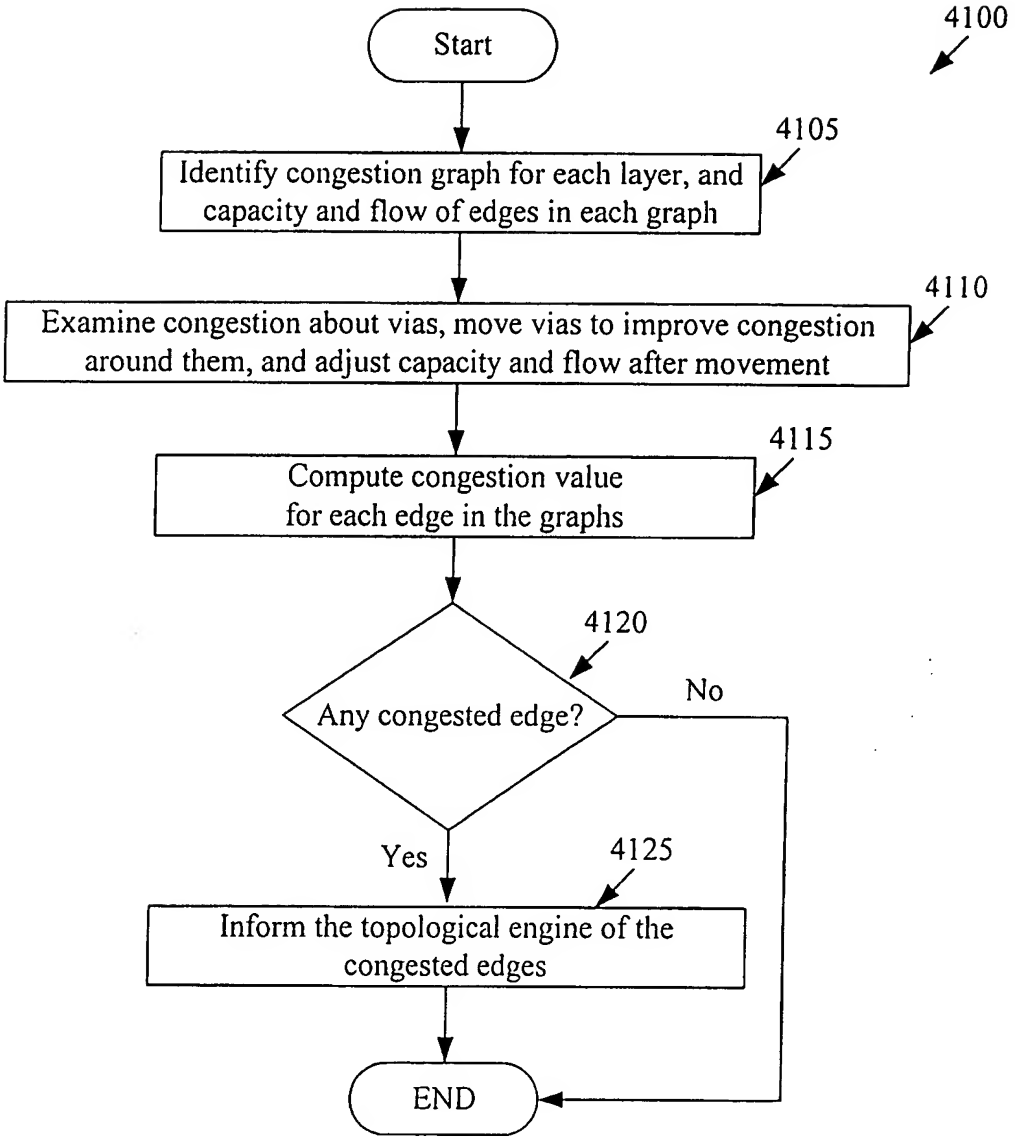

4100
Start
4105
Identify congestion graph for each layer, and capacity and flow of edges in each graph
4110
Examine congestion about vias, move vias to improve congestion around them, and adjust capacity and flow after movement
4115
Compute congestion value for each edge in the graphs
4120
Any congested edge?
No
Yes
4125
Inform the topological engine of the congested edges
END

Figure 41

20F070"h6099803F

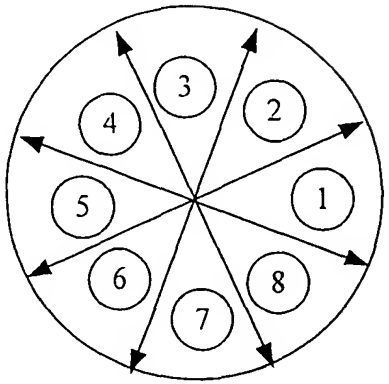


Figure 42

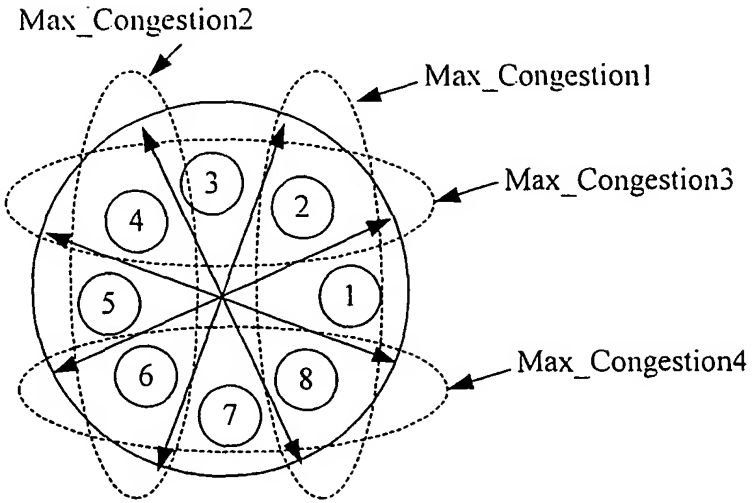


Figure 44

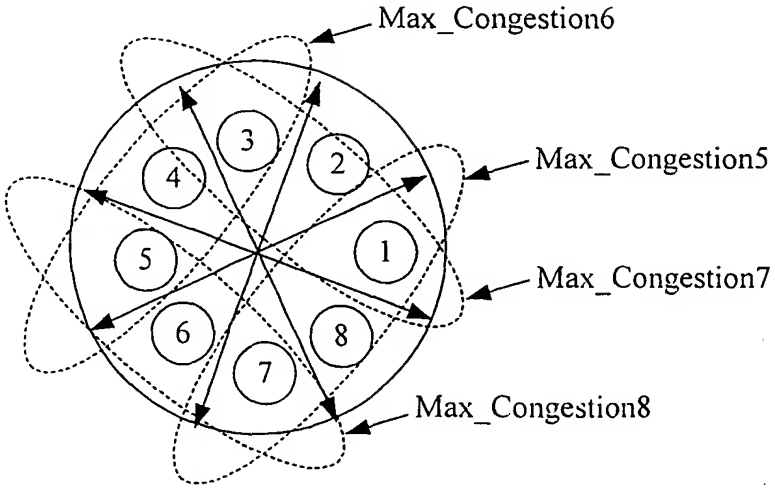


Figure 45

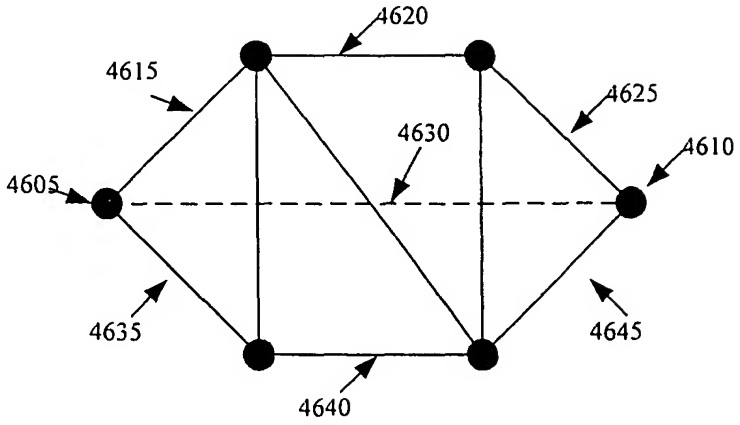


Figure 46

EP 2 096 564 A1

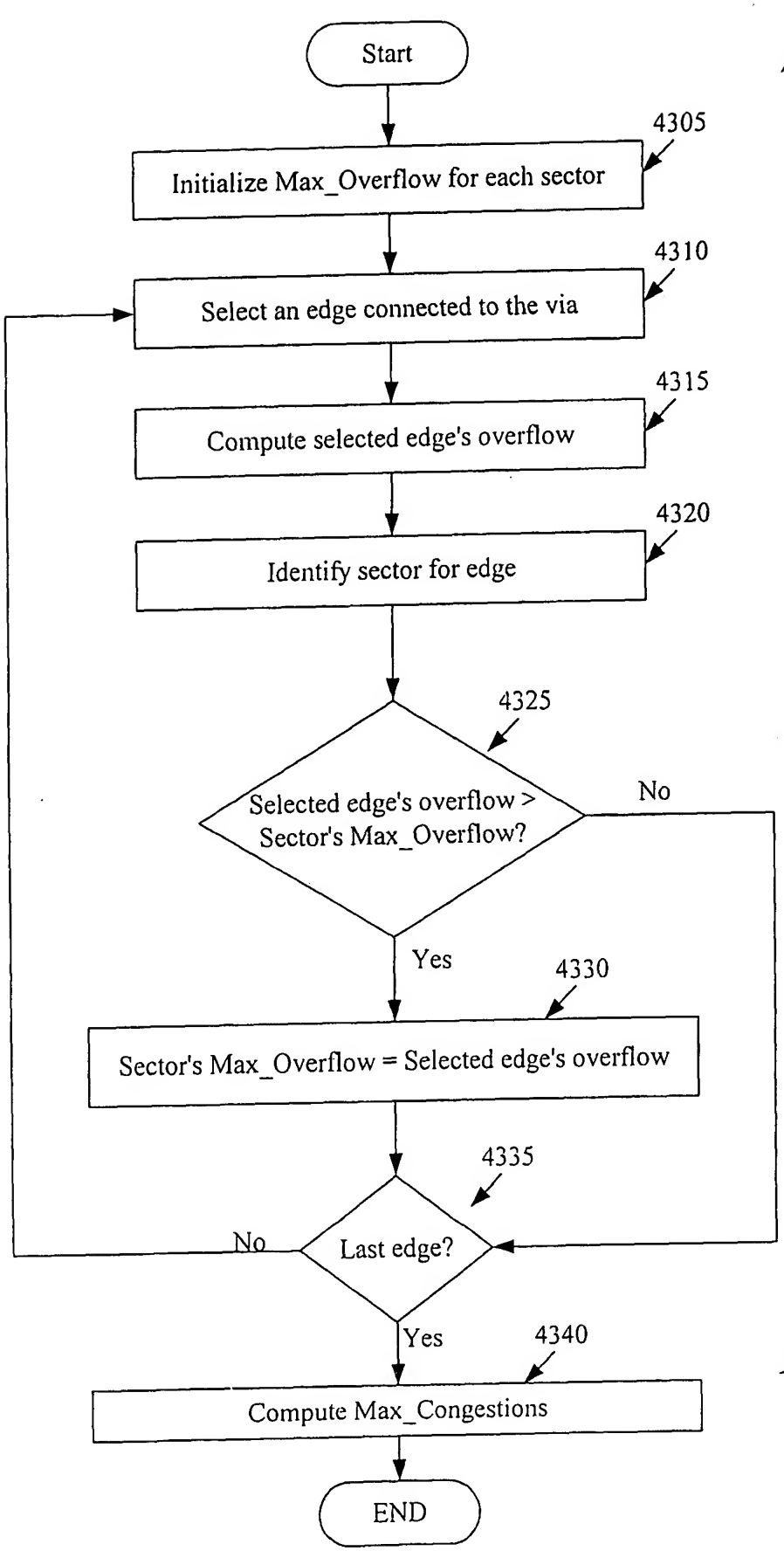


Figure 43

20040070204

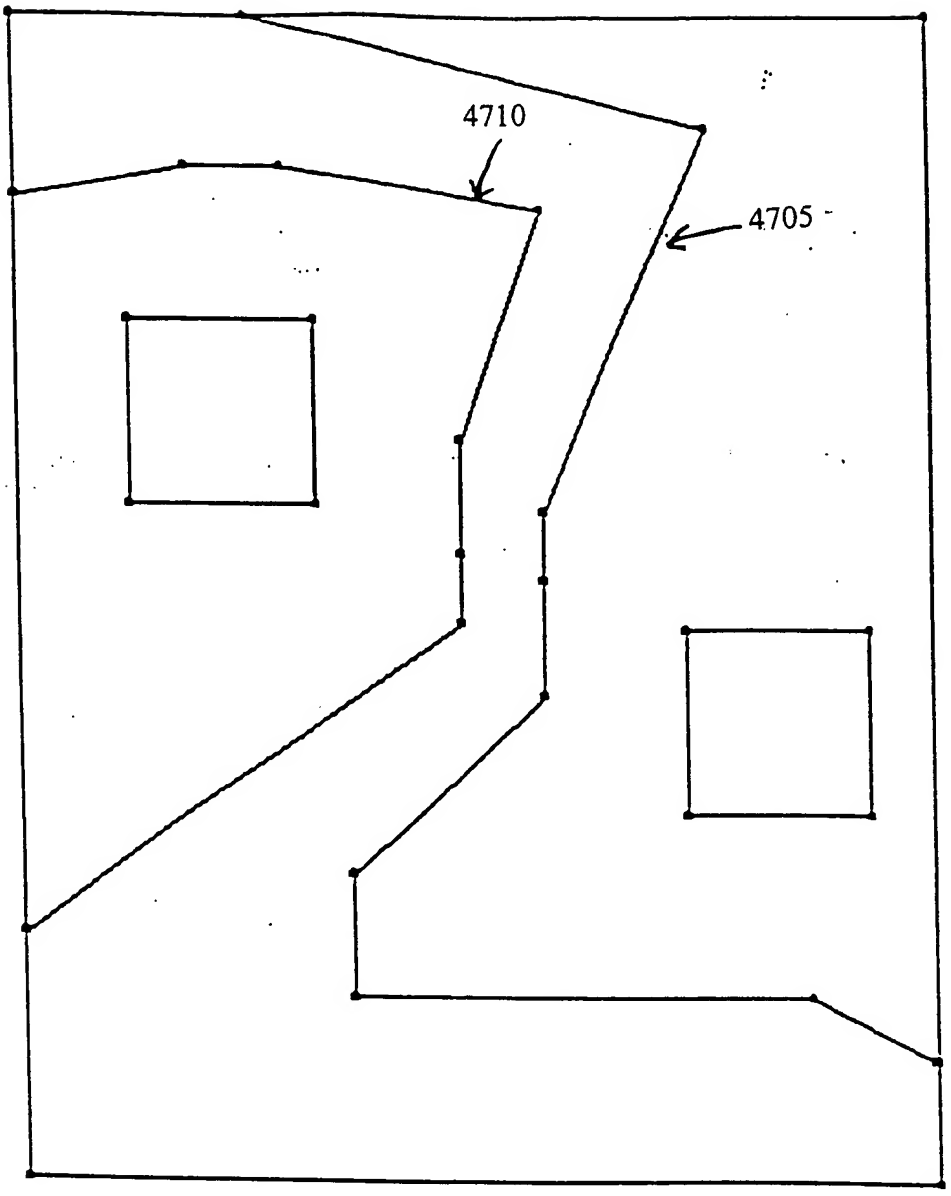


FIGURE 47

10650544 - 070102

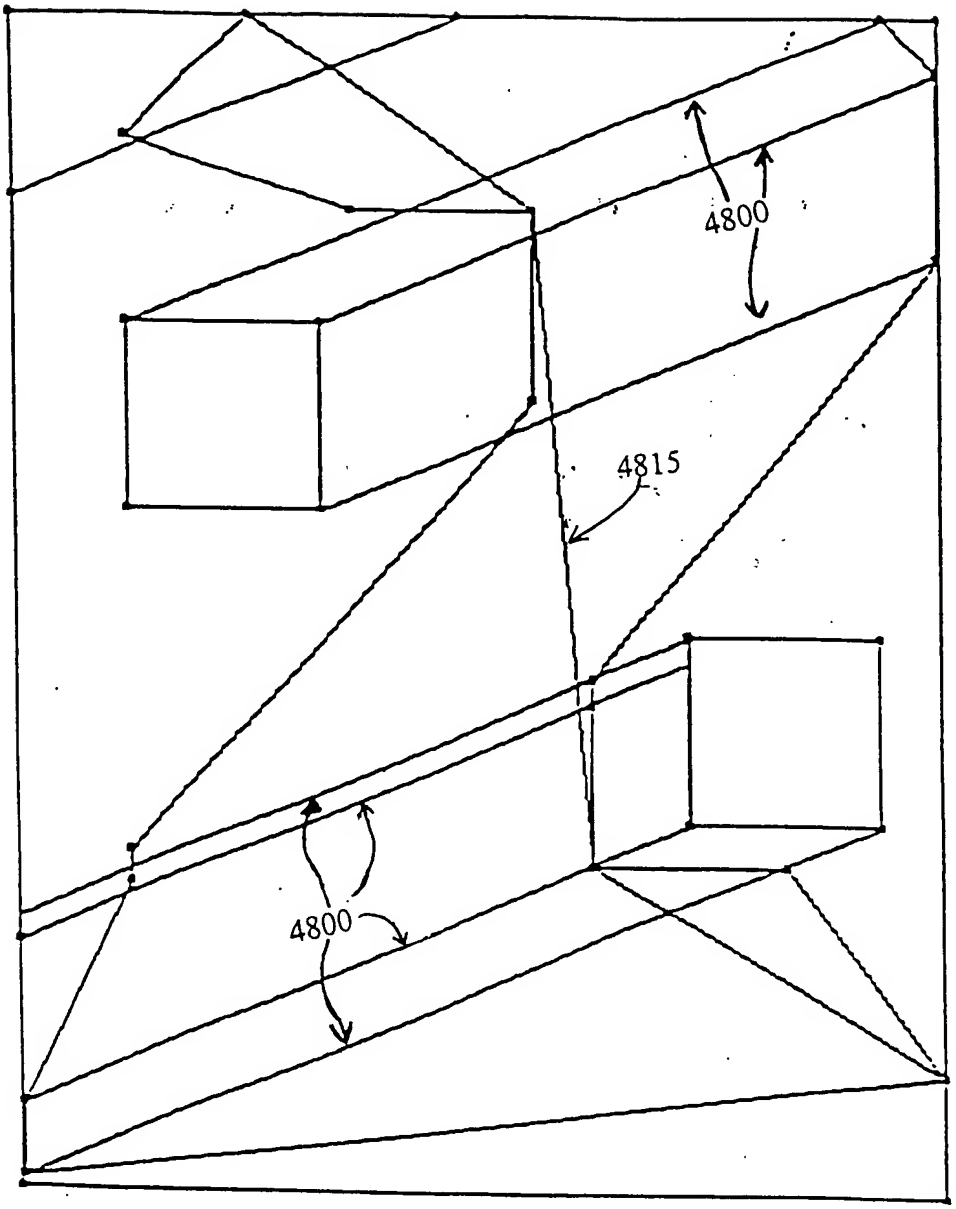


FIGURE 48A

20120705-1056454-0900201

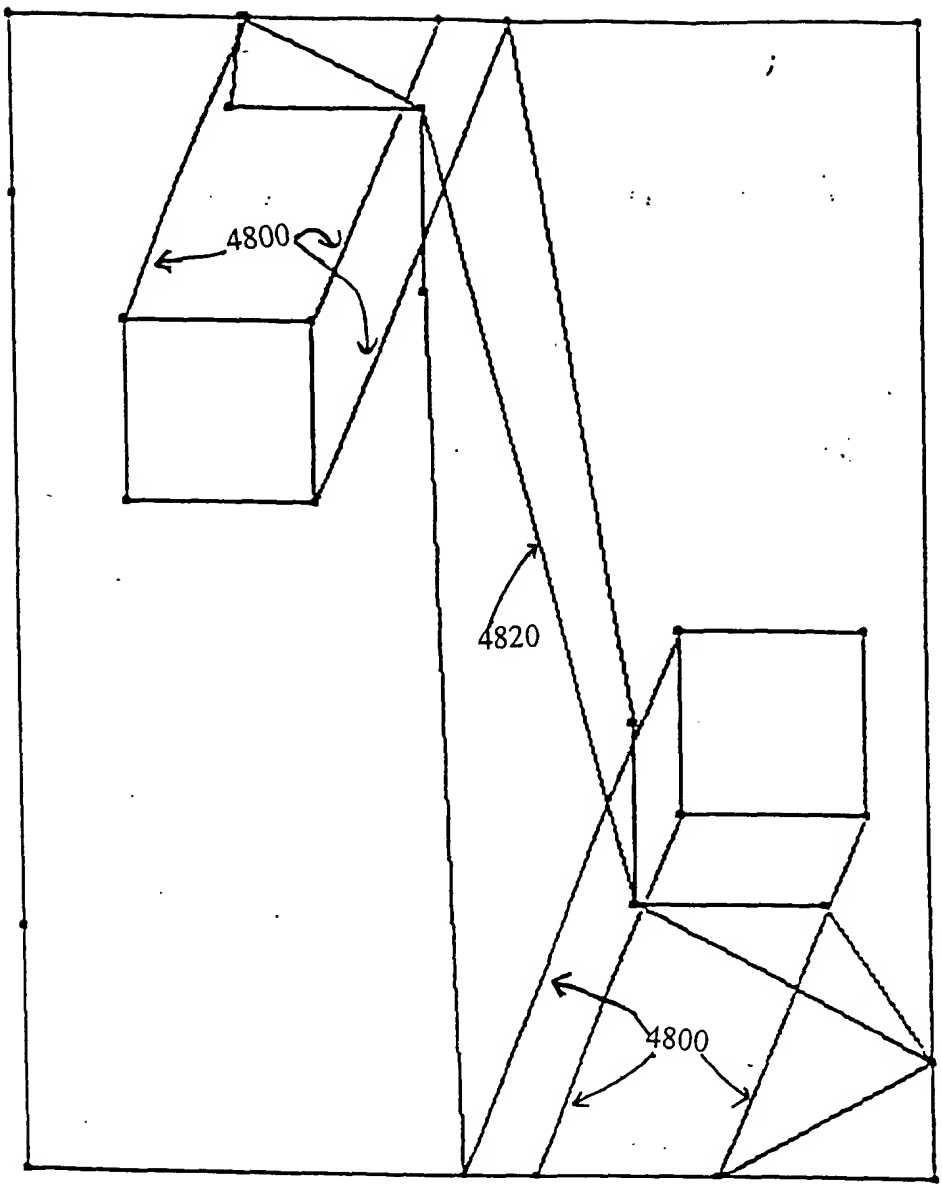


FIGURE 48B

20120704-0705.pdf

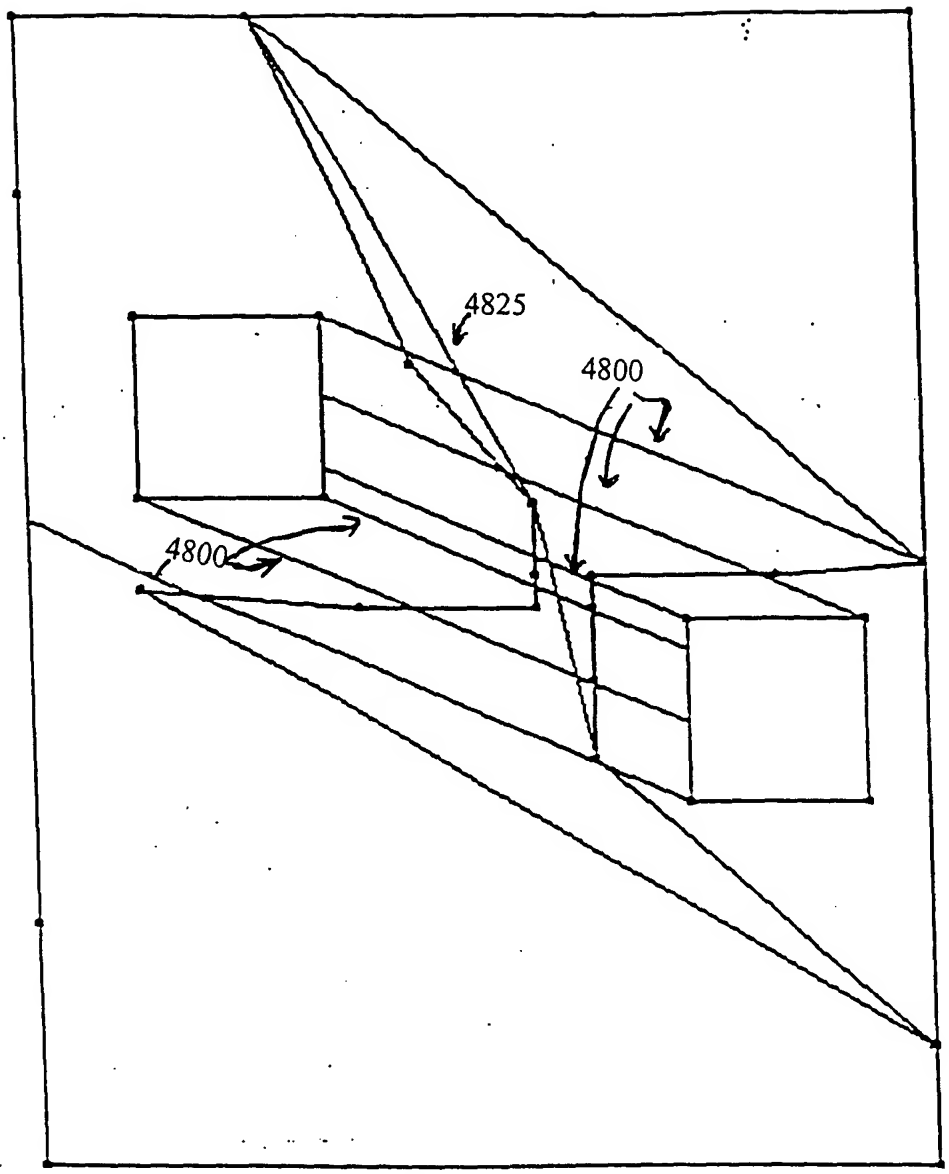


FIGURE 48C

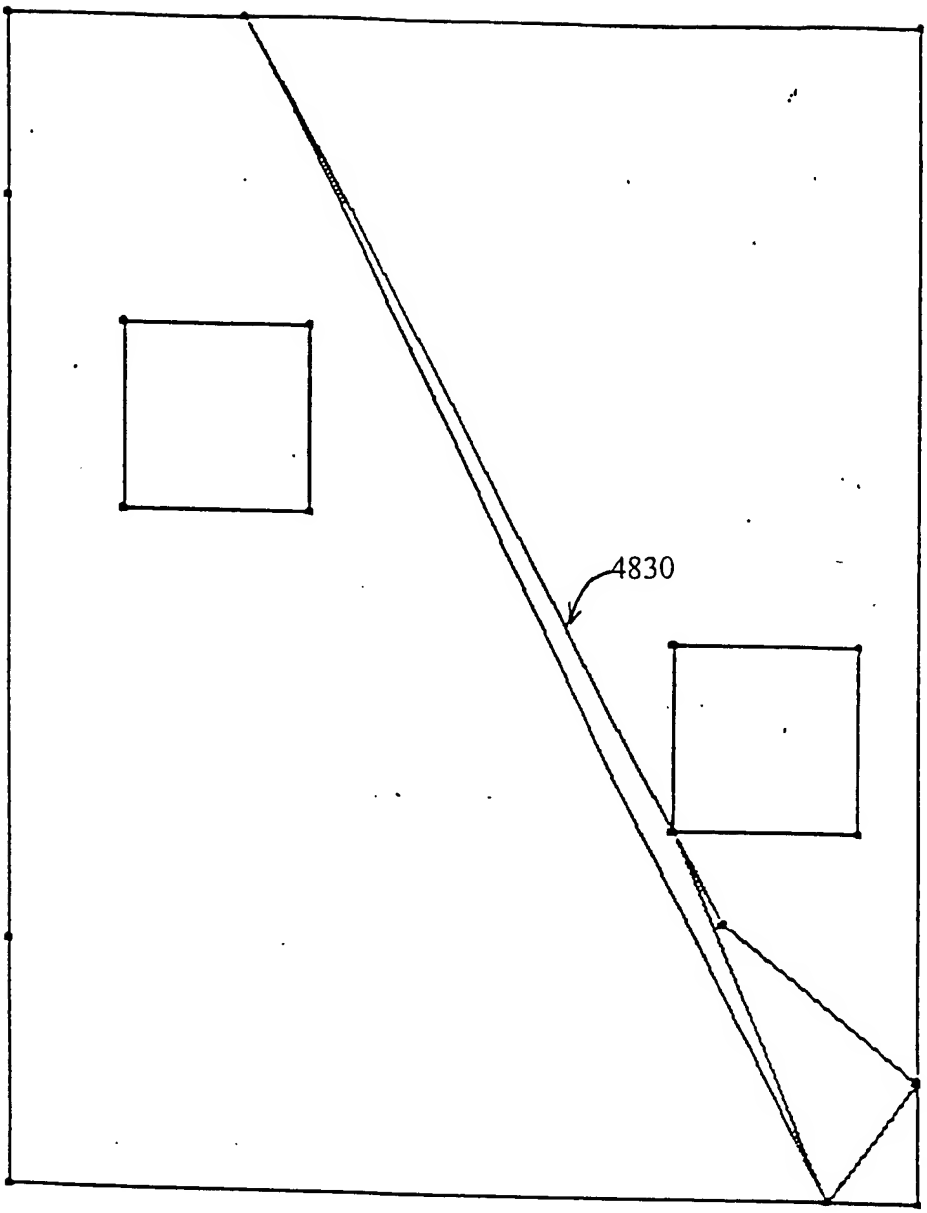


FIGURE 48D

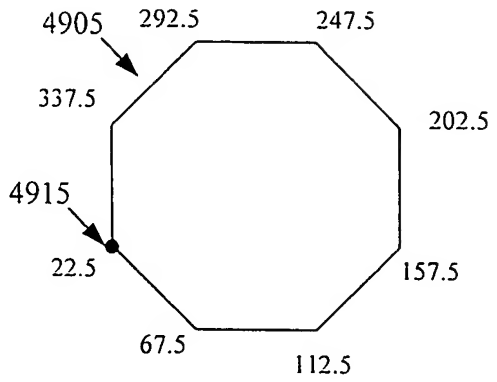


Figure 49A

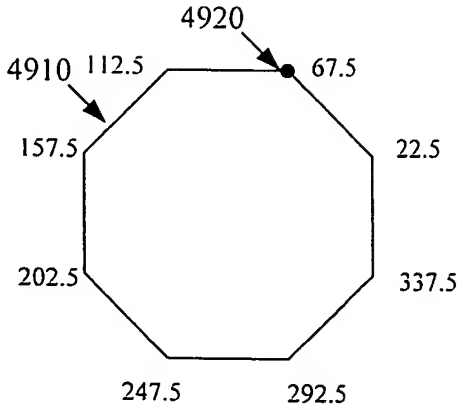


Figure 49B

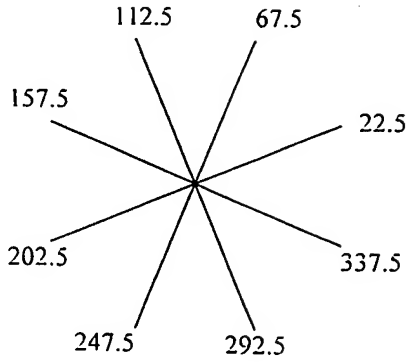


Figure 49C

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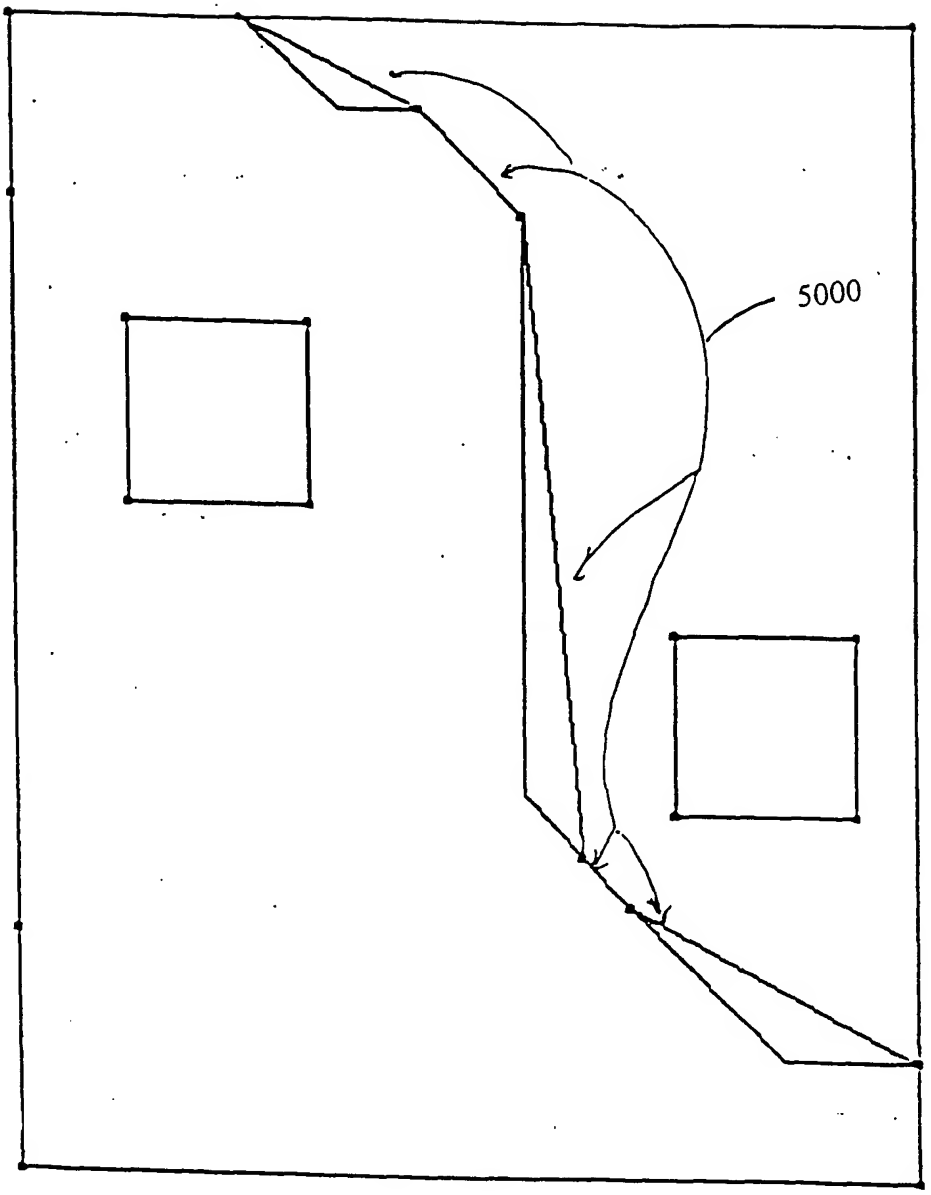

FIGURE 50

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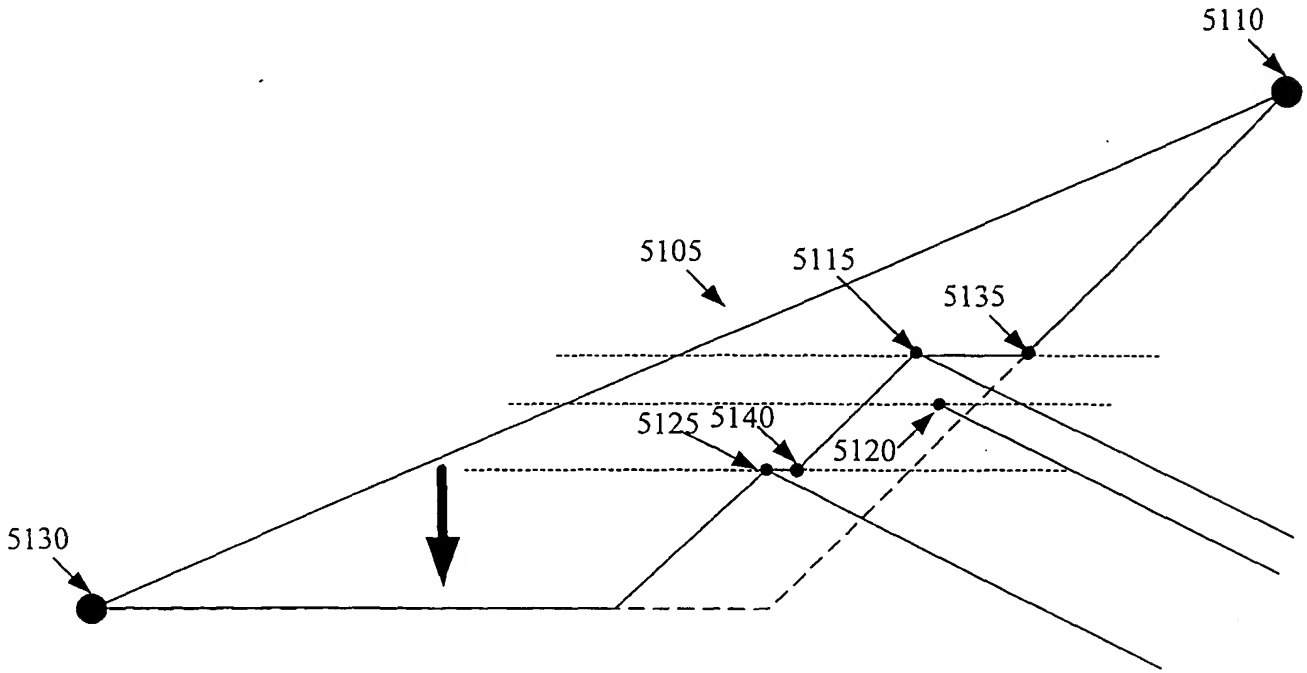

Figure 51

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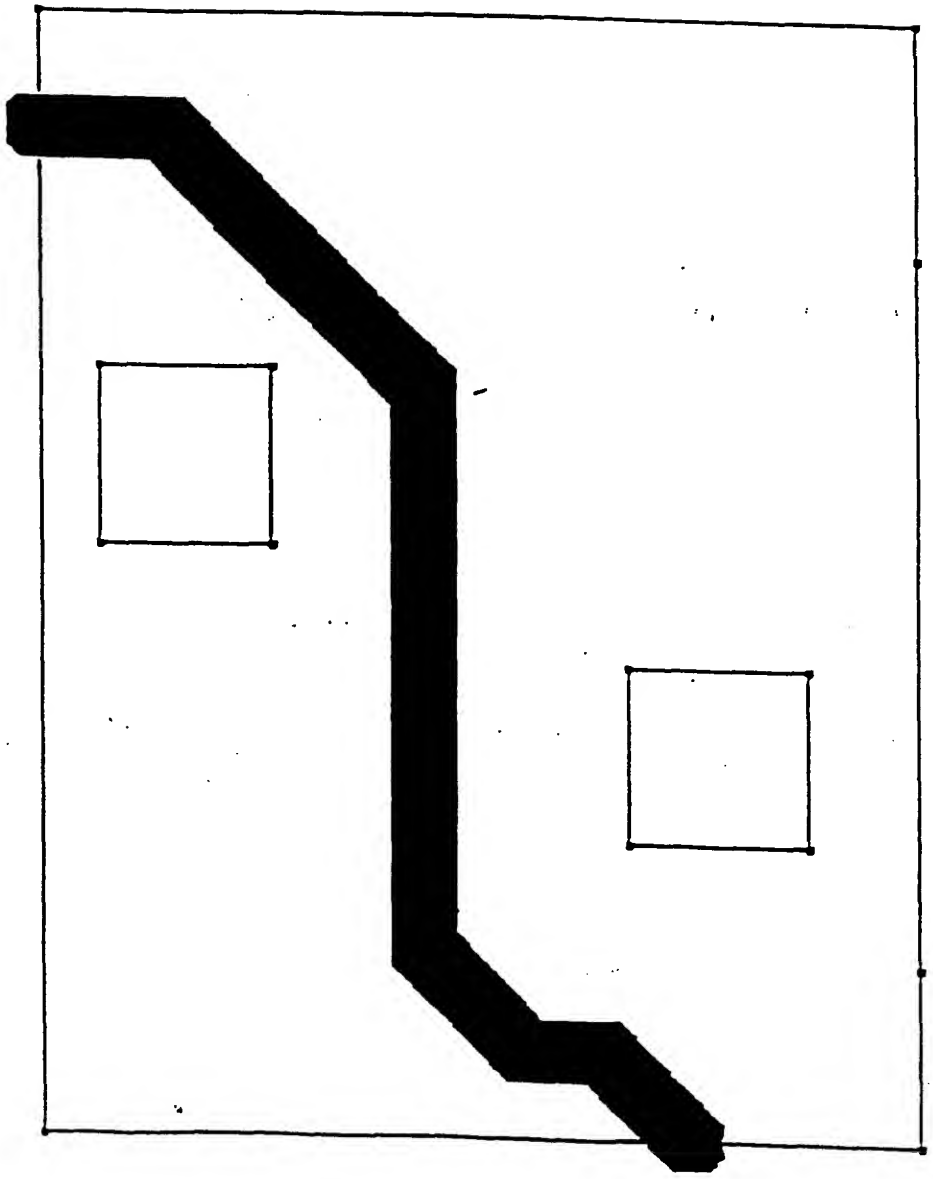

FIGURE 52

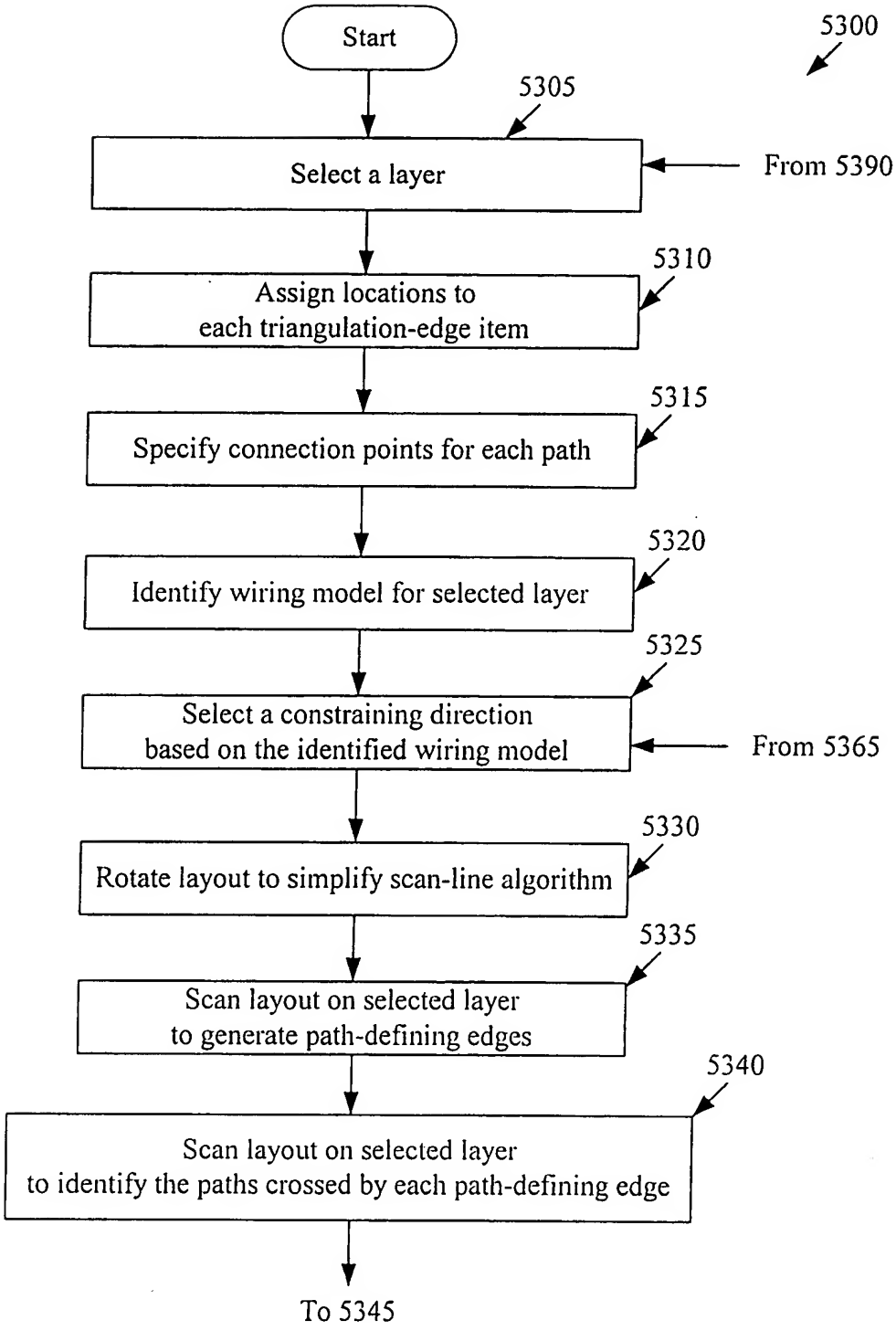

Figure 53

Figure 53: *Figure 53A* / *Figure 53B*

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20150204-4950907

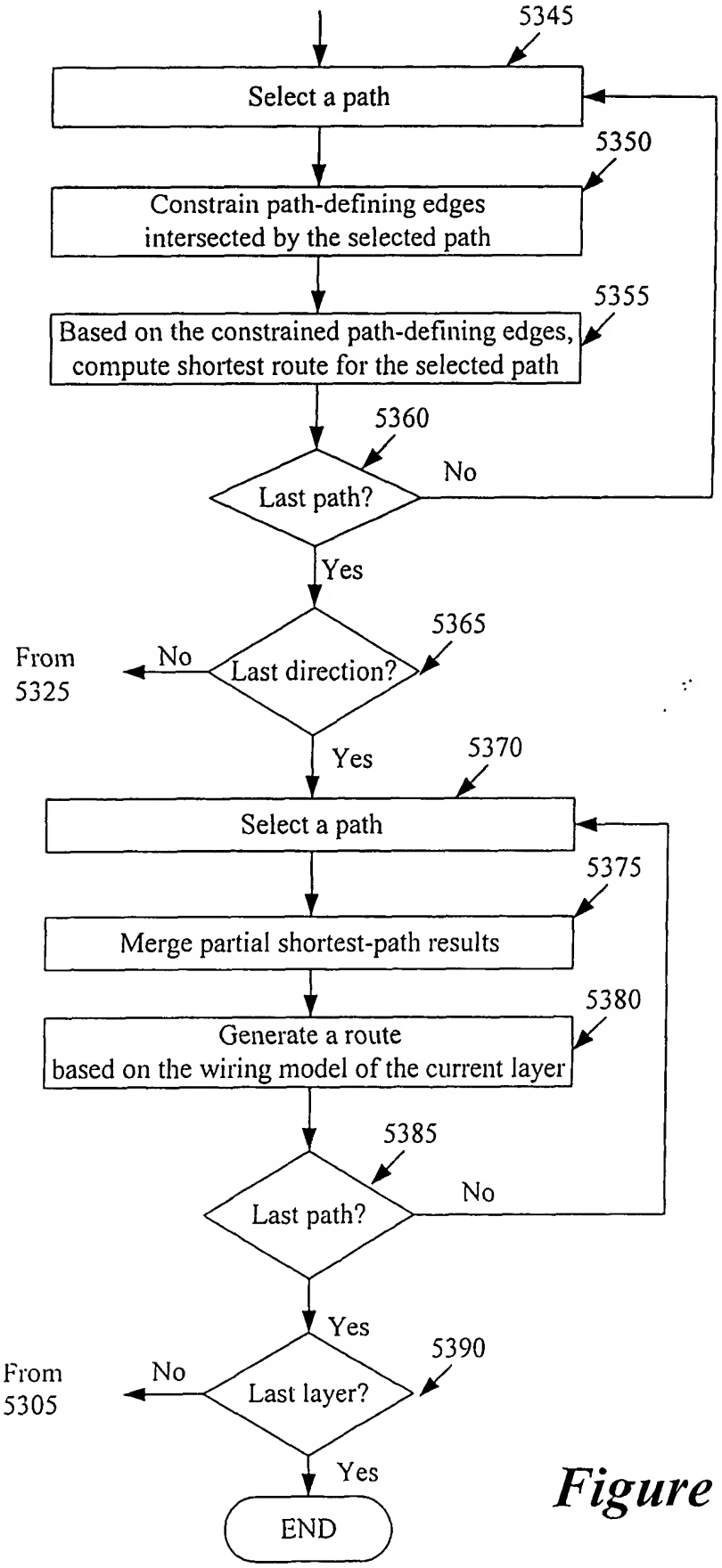

Figure 53B

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Figure 55

Figure 54

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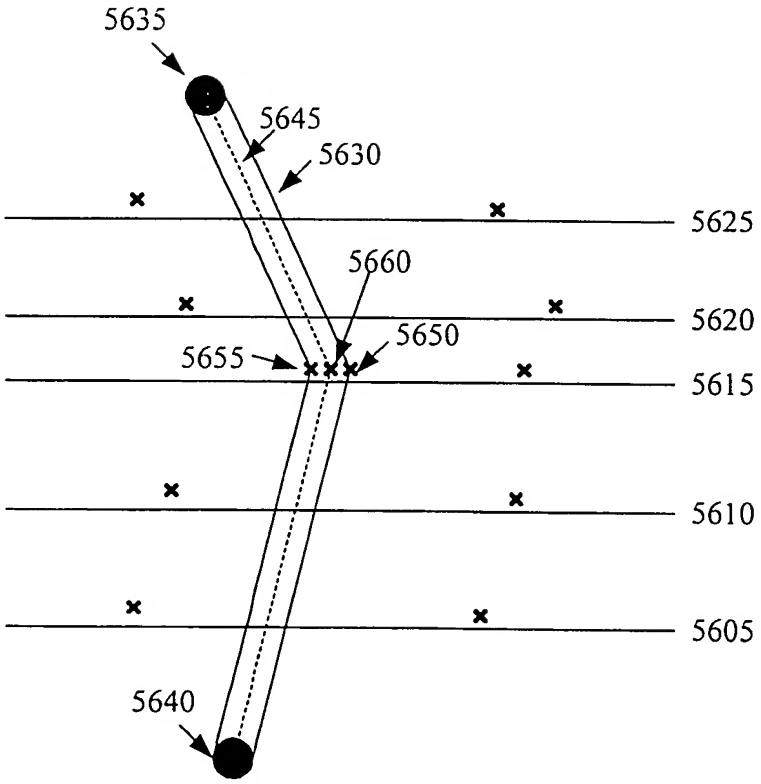

Figure 56

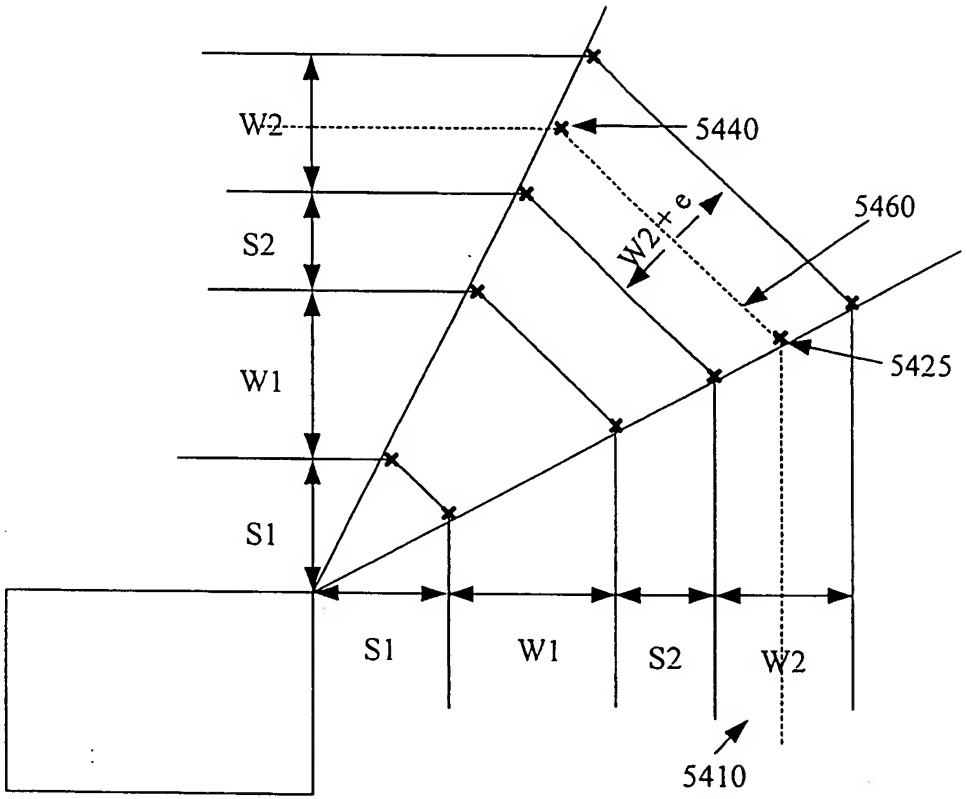

Figure 57

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Figure 58

Figure 59

Figure 60

Figure 61

Figure 62

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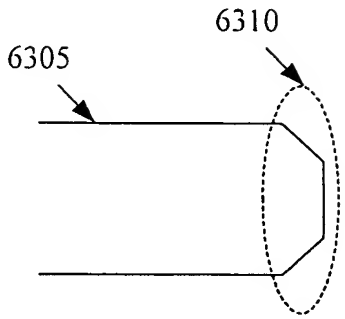

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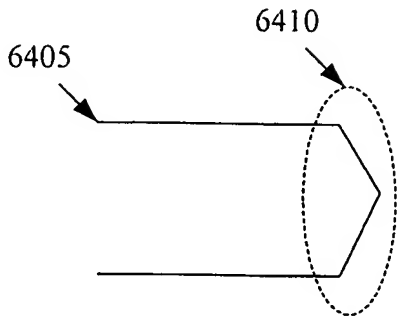

Figure 64

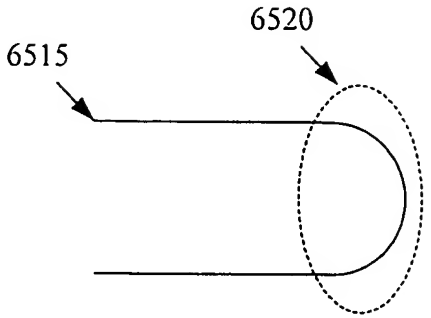

Figure 65

(1) *(2)* *(3)*

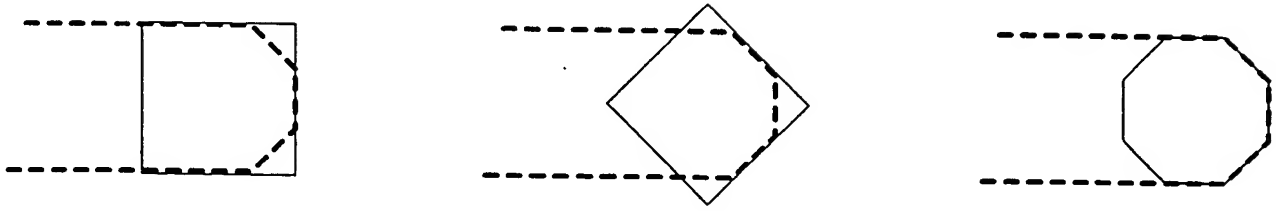

Figure 66

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Figure 67

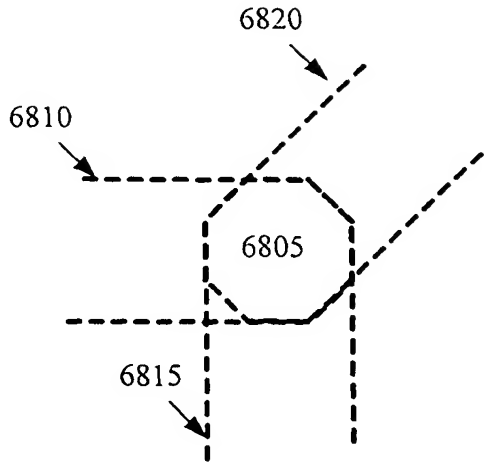

Figure 68

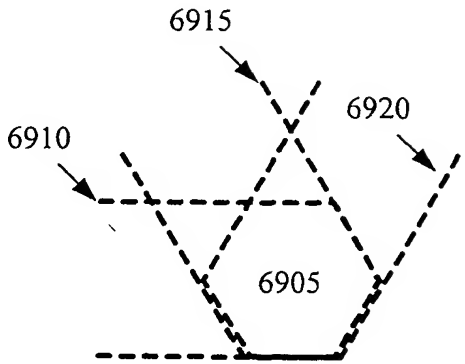

Figure 69

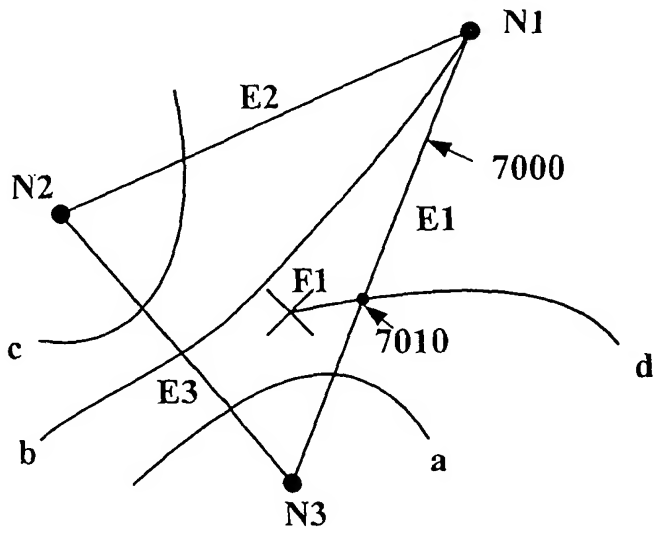

Figure 70

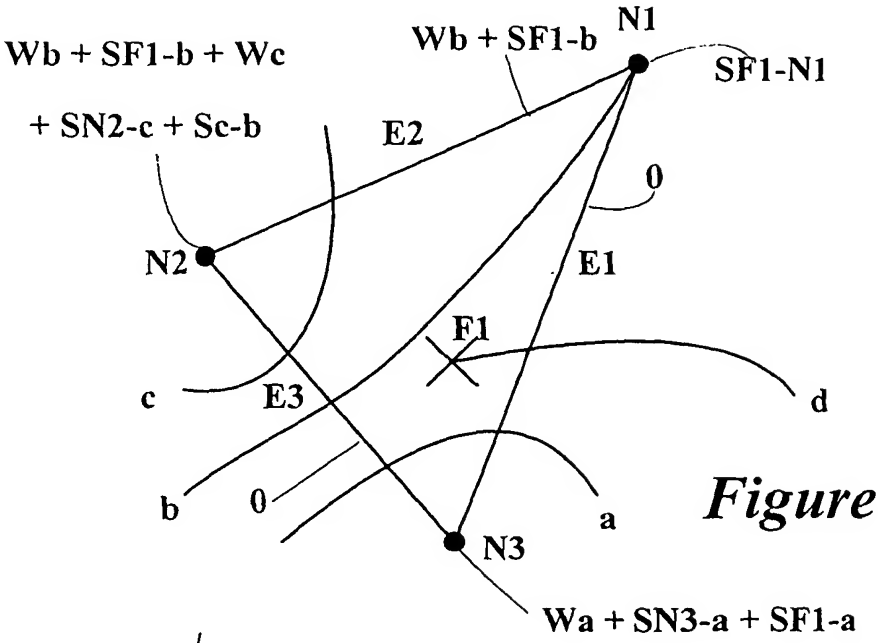

Figure 71

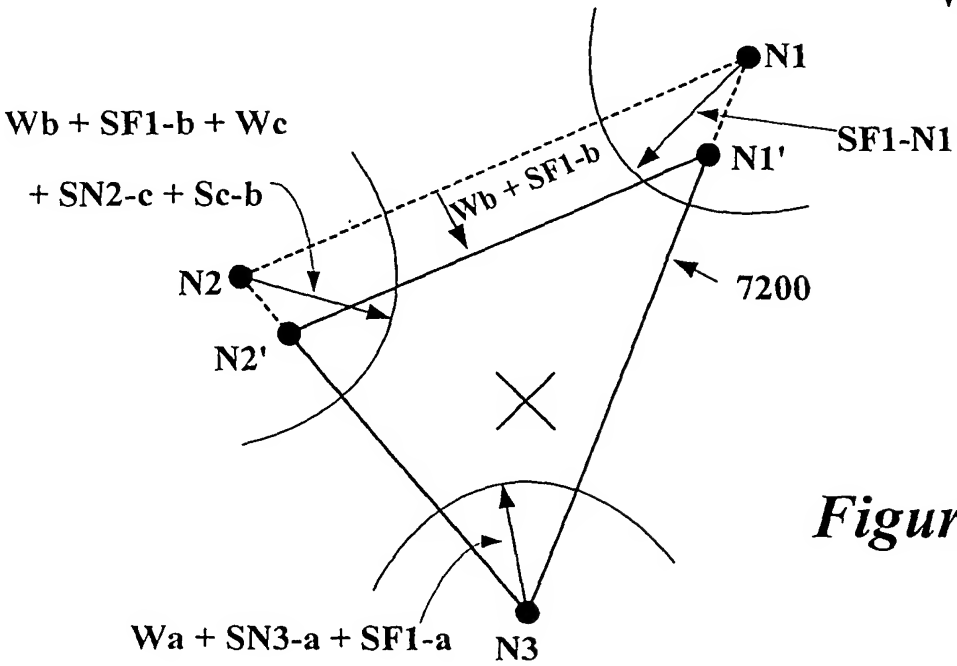

Figure 72

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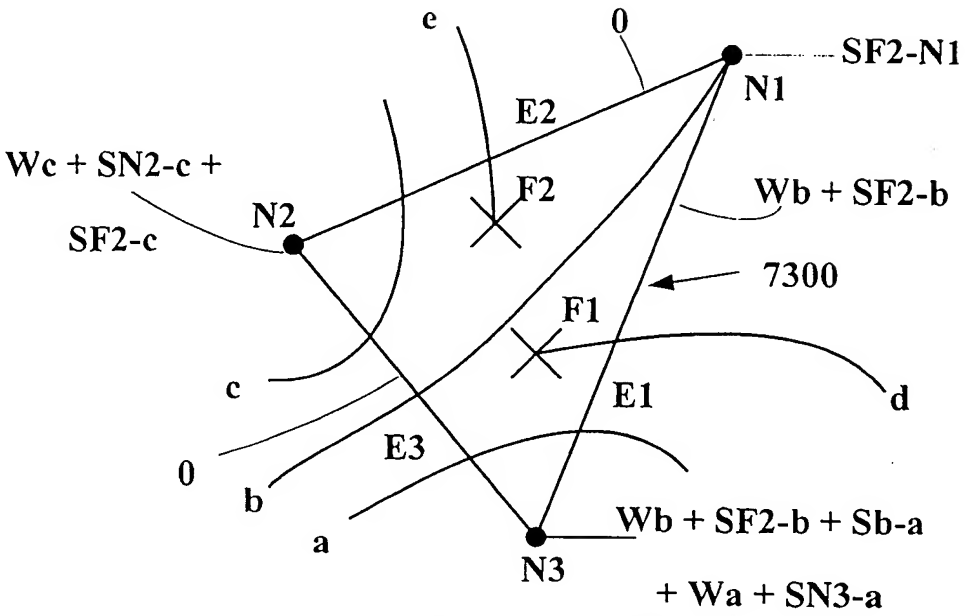

Figure 73

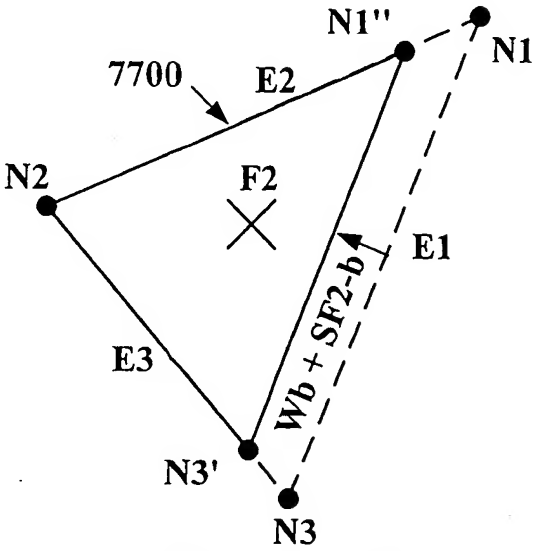

Figure 77

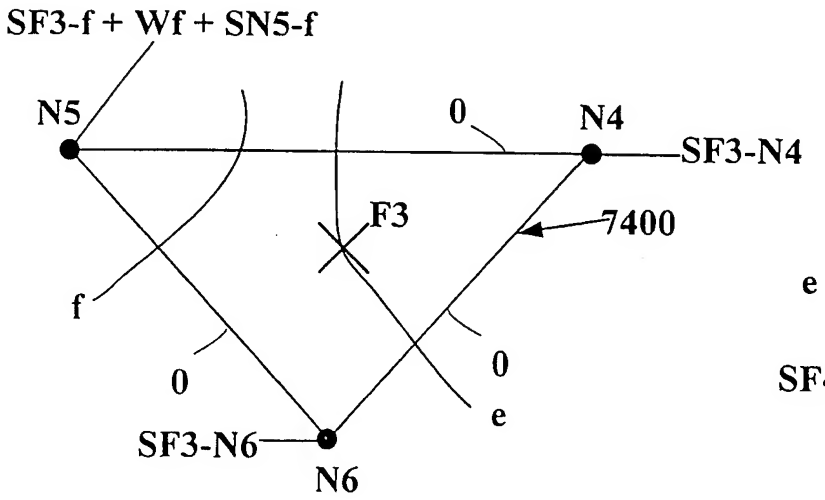

Figure 74

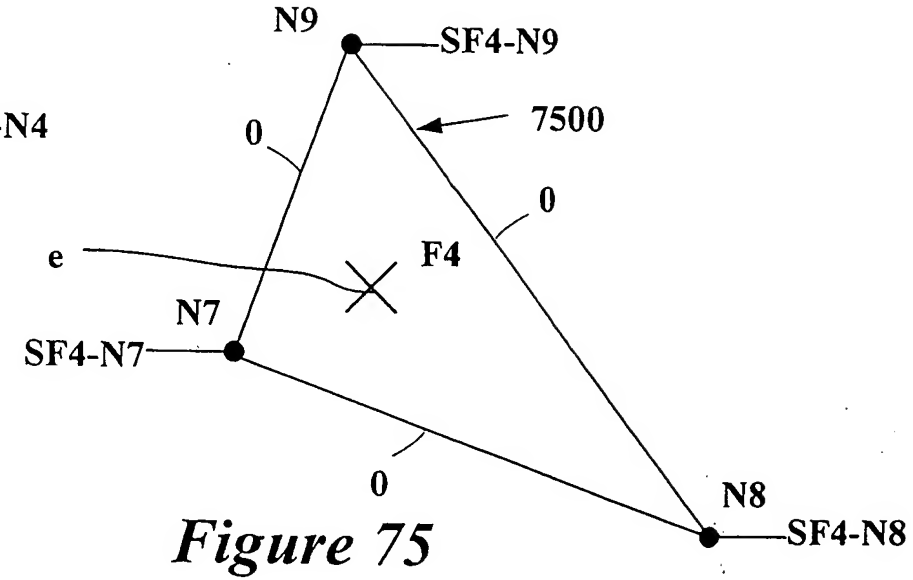

Figure 75

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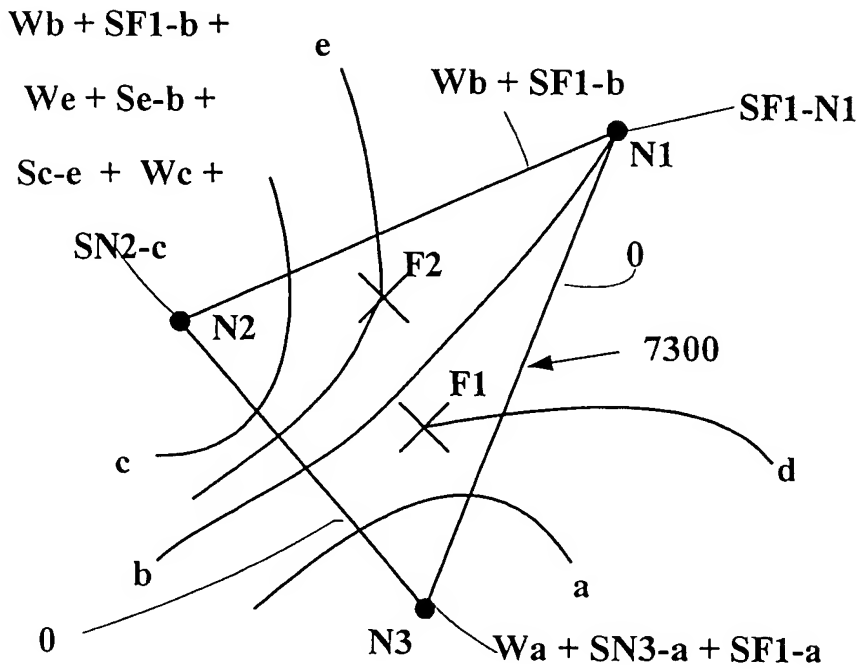

Figure 76

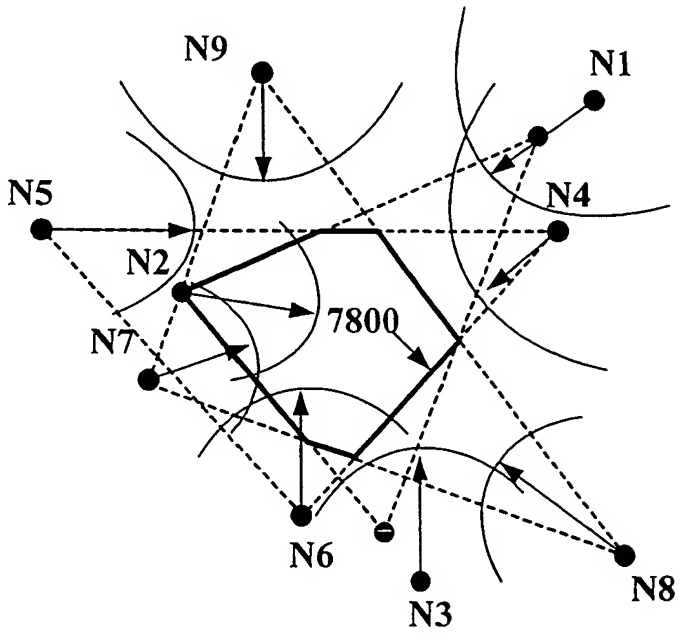

Figure 78

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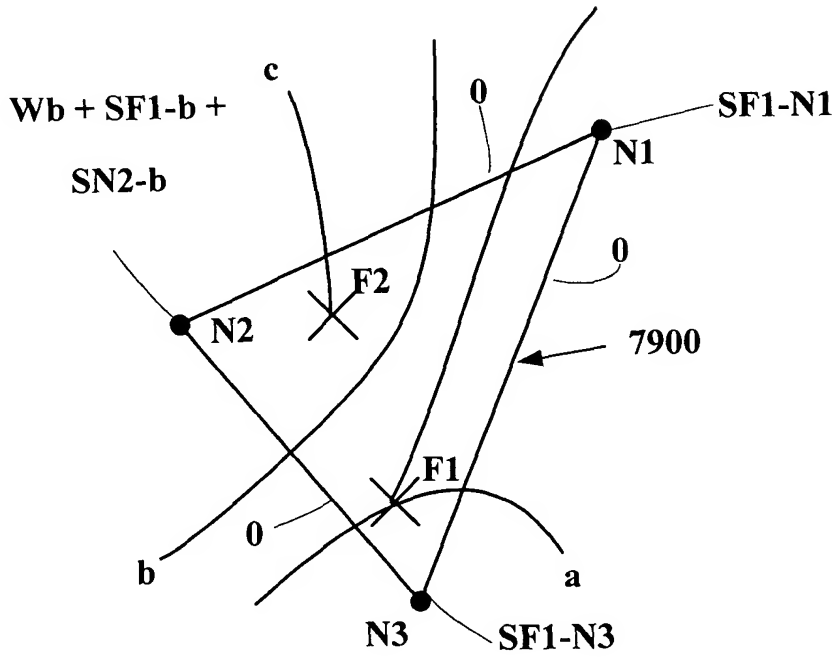

Figure 79

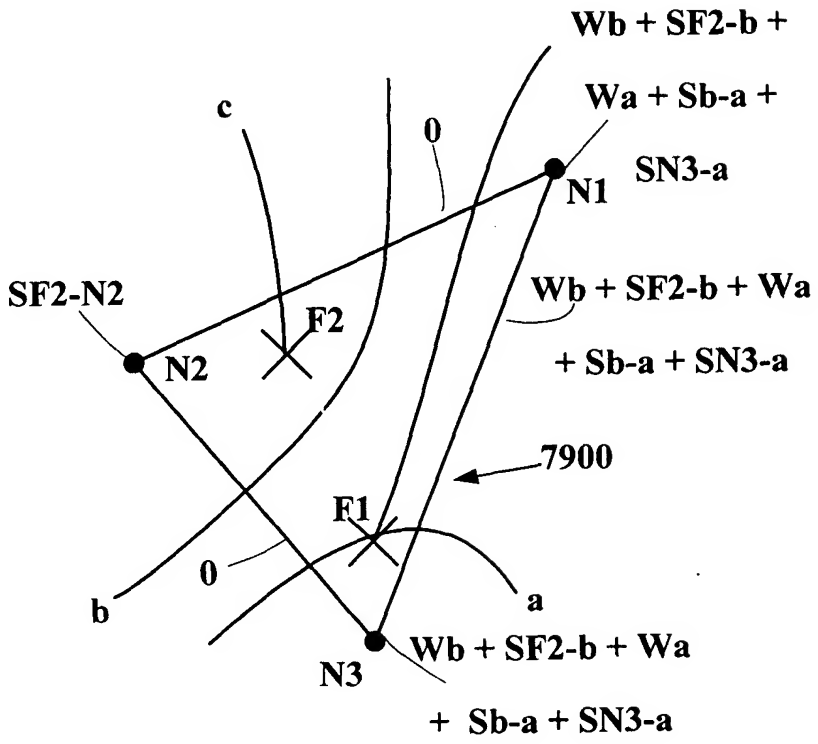

Figure 80

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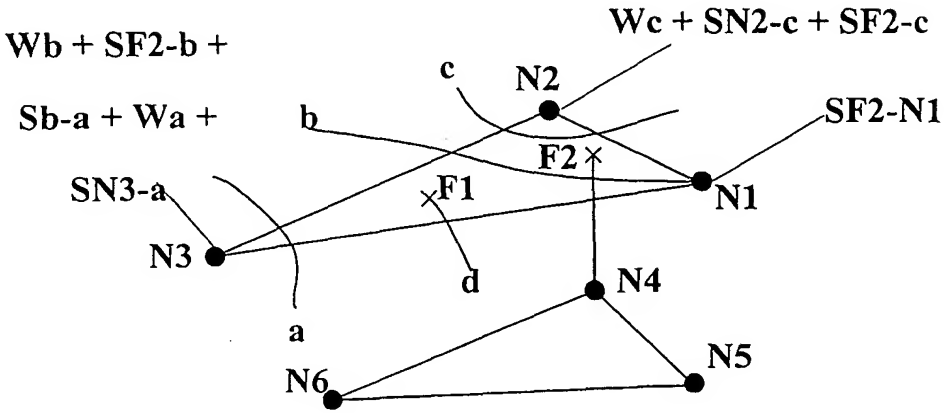

Figure 81

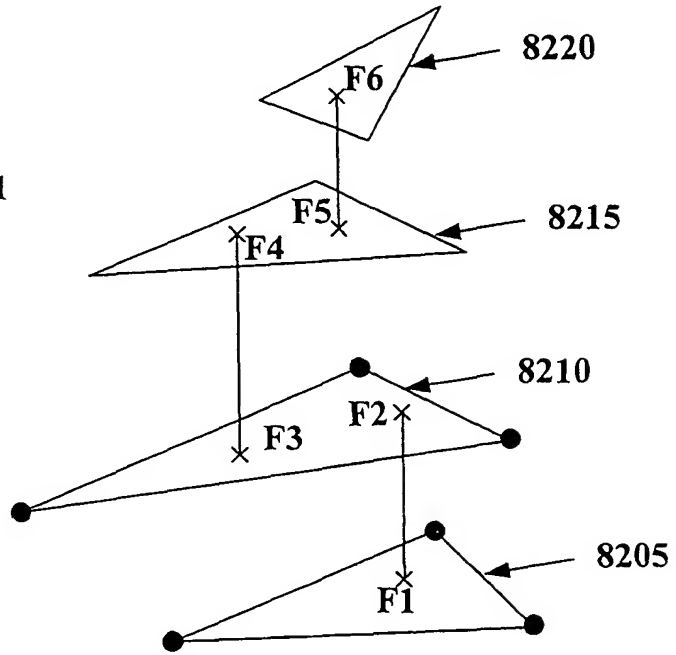

Figure 82

20T070-h6099001

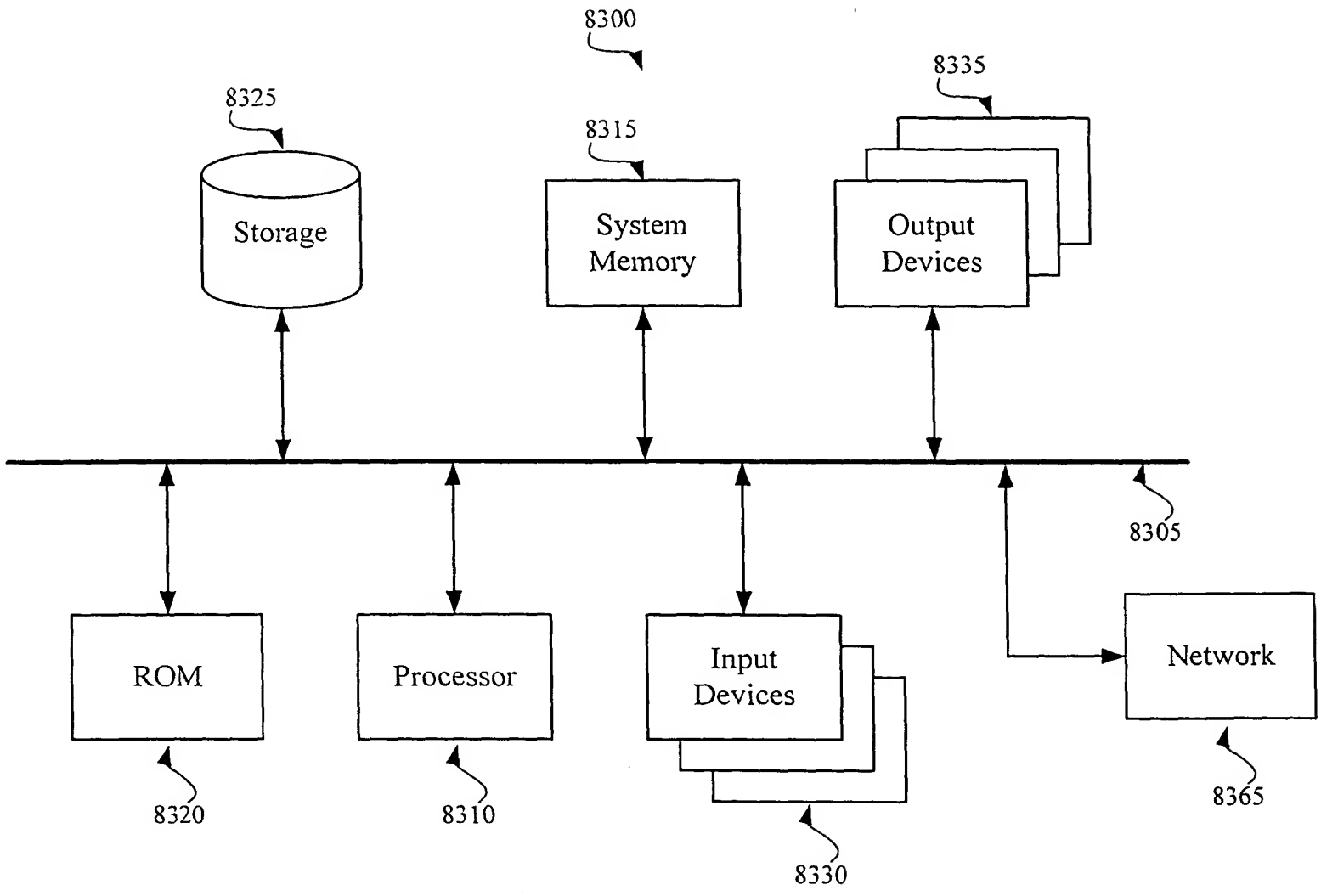

Figure 83